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*Illustrated.

THE time is ripe for the adoption by the railways of the United States of a standard box car. This type of car, designated by the commission on car service which was recently appointed by the American Railway Association as "legal tender equipment," is so generally interchanged and the practice of the home route is so wasteful that the commission has made the suggestion that all box cars be placed in a pool which can be governed by regulations that will insure the best service being obtained from such cars by the railroads generally. Such a movement, which would naturally lead to the adoption of a general standard box car, if suggested a few years ago, would have had little chance of being put through—and it is possibly just as well that it was not attempted. At the present time, however, sufficient experience has been gained from the different types and designs of box cars to enable a standard box car to be decided upon which should give excellent results from the construction, maintenance and service standpoints, and should thus receive the support of the mechanical and operating officers. The splendid returns which have been received from the publication of the car balances and performances by the American Railway Association and the results which have already been accomplished by the commission on car service and the recommendations which it has made would seem to insure the hearty support of the executive officers to such a movement. It would not be surprising if the American Railway Association should ask the Master Car Builders' Association to present its recommendations for a standard box car in the very near future.

THE twenty-sixth annual report of the Interstate Commerce Commission for the fiscal year ending June 30, 1912, contains a number of tables relating to the causes of accidents, and among them is a special compilation of those that have been caused by wheel failures. In 1912, for example, there were 3,847 accidents due to defective equipment, of which 984 were caused by broken wheels, and of these 627 were broken flanges. The report contains a tabulation of such wheel failures for eleven years, 1902 to 1912 inclusive. Comparing the first two years of this period with the last two, we find that for 1902 and 1903 there were 1,011 accidents caused by wheel failures as against 1,800 for 1911 and 1912, showing an increase of 78 per cent. in the total number. These figures cannot be taken, by themselves, to present an accurate statement of the case, because they take no account of the increase in traffic that has occurred between the two dates. In 1902 and 1903 the total ton-mileage of the United States was nearly 331 billion; in 1910 and 1911 it was nearly 509 billion. (The figures for 1912 have not yet been compiled.) This shows an increase of 54 per cent. in tonnage carried, or 24 per cent. less than the increase of wheel failures. If the comparison is to be made on the basis of car mileage, figures for the whole country are not available for later than 1910; but taking those from four representative railways, the Pennsylvania, Union Pacific, Illinois Central and Chicago, Rock Island & Pacific, we find that the empty car mileage increased 44 per cent. and the loaded car mileage 58 per cent. in the eleven years covered by the report. At the same time, the car loads increased 9 per cent. From the operating standpoint, then, wheel failures have increased faster than ton mileage, car mileage or car loading. If wheel failures had increased at the same rate as loaded car mileage the failures for 1911 and 1912 would have been 1,597 instead of 1,800, which is an increase of 12.7 per cent. above what would have been a normal increase; and it seems fair to attribute a part, at least, of this to the 9 per cent. increase of average wheel loads.

THE Pennsylvania Railroad has decided to electrify its line from Broad street, Philadelphia, west, 20 miles, to Paoli—a beginning which probably means, ultimately, a very extensive change, for the company's lines centering at Broad street extend in five different directions; to New York, to Reading, to Pittsburgh, to West Chester and to Washington. It is about two years since a committee was appointed from among the officers of the several departments of the road to consider the subject of the enlargement of the facilities in Philadelphia and some of the preliminary details were decided on some months ago, including the remodeling and enlargement of the North Philadelphia station, and the construction of eight main tracks at that point, a "detail" which will cost $1,000,000. Now, the board of directors has authorized the electrification of the main line, as above noted, for suburban passenger traffic. No further

details than the mere fact of the decision have been given out, because none have been decided. The problem is an exceedingly complicated one, involving, as it does, as great a provision for future growth and traffic as possible, in which even an outlook of twenty years ahead is too short a time to be considered. The question must be viewed not only in the light of the immediate and coming needs of the twenty miles to be converted, but as to its influence on and inter-relationship with the other developments suggested. For these reasons the system to be used has not yet been decided. While it is expected that this particular improvement may be completed in 1914, it is, to a great extent, dependent upon the expedition with which negotiations can be carried on with the city as to the land that will be required and the acquisition of the property on Filbert street, which bounds the present terminal on the north, all of which will take considerable time. Involved in the scheme is some six-track improvement work, which, with the widening of the Broad street station, will afford the much needed terminal relief. Of all of this work, the first step to be undertaken will be, as previously announced, the construction of an eight track station at North Philadelphia coupled with the increased tracking of that section of the road, the Connecting Railway, which includes a new arch bridge across the Schuylkill river at Girard avenue.

SCIENTIFIC MANAGEMENT.

MORE meetings or forums should be held throughout the country like that of the Western Economic Society at Chicago last week, when for two days the subject of scientific management was discussed from the standpoints of the employer, the employee, the engineer and the social worker. As we have said repeatedly in the past, there is undoubtedly much merit in the principles of scientific management, but the application of these principles is so little understood, and their introduction requires so much careful and painstaking investigation, as well as a radical change in the relation of employer and employee, and their attitude toward each other, that it will require years—possibly a generation or two—before they can with success be generally introduced; and this is particularly true in those fields where they are not so susceptible of application as in certain classes of manufacturing establishments and machine shops. Meanwhile it will be necessary to conduct a vigorous and systematic campaign of education to bring both the employer and employee to see their value and to co-operate with each other in their introduction. And this is a most vital point, for unless the principles are rightly applied, much harm may be done, and in the words of one of the speakers at the conference, "Scientific management may become a nuisance."

One of the most effective addresses was that by Morris L. Cooke, director of public works of Philadelphia—and it was effective because of the big-hearted, broad-minded conception of scientific management which he is striving to work out as a public officer. He spoke of scientific management as a means of ameliorating the condition of the toiling classes, and this thought was emphasized time and time again during the conference by those who have been notably successful in using it. Attention was directed to the fact that although F. W. Taylor has developed and used the principles of scientific management for many years, and has presented papers on his work before our great engineering societies, still, until two years ago, he was hardly known, even in his own city. At that time the awakening of the public to the necessity of the conservation of energy and material had made the time ripe for an announcement concerning it. Louis D. Brandeis, in the hearing of the freight rate advance cases, startled the country with it, and in a way made unfair use of it, for industrial organizations, schools, the management of the home, and almost everything else done by human agency was just as inefficient from the standpoint of scientific management as were the railways—and in many cases probably more so.

It was, therefore, of special interest to hear a man like Mr. Cooke, who had worked with Mr. Taylor, say that in spite of the fact that many thousand men were working under scientific management the number was so relatively small that it might truthfully be said that almost 100 per cent. were not working under it, and that probably as much as two generations would be required to educate the public to adopt it generally.

From the statements of the representatives of the labor interests who were present, and especially of John P. Frey, editor of the *International Moulders Journal*, whose arguments and personality made a strong impression on those in attendance, it is evident that organized labor is bitterly opposed to the new methods and that much hard and patient work must be done to bring its representatives to see that the men will not be imposed upon, but that as one speaker said: "There is a vast difference between strenuosity and efficiency." And it must be apparent to any close observer that just as piece-work and bonus systems have failed of securing the best results where they have been abused by the employer, so any other system must fail if the men are not given a square deal.

One thing is going to delay the general introduction of the new principles for many years, and that is that so few men are actually fitted to introduce them and that so many fakirs have rushed into the field. Carl Barth expressed it well when he said that it often made him so heartsick that he sometimes felt like giving the whole thing up. To develop a trained leader in this field should require at least as much time as to train a first class physician, and yet look at the number of so-called "efficiency experts" who have sprung up like mushrooms in a night! Near the close of the session one factory manager who had introduced scientific management with good results asked if there was no way in which these fakirs could be driven from the field; no one could suggest a solution of the problem.

The last session on Saturday afternoon was in the nature of a summary and a questionaire, and in the absence of F. W. Taylor, who was detained because of illness, F. B. Gilbreth and Morris L. Cooke answered the questions which had been presented. It proved to be a most interesting session and because of the ability and thorough training of these two gentlemen and the evident sincerity of their efforts in trying to better the condition of the laboring classes, produced a profound impression on those present which was not even dissipated by a fiery and equally sincere attack on scientific management by the well-known anarchist, Emma Goldman, which, by the way, gave a good idea of the patient effort which it will be necessary to exert in dealing with organized labor along these lines. In this connection it may be of interest to know that Mr. Gilbreth has published a book* entitled "Primer of Scientific Management" which is based on answers to questions and objections which have been made by workmen in criticizing scientific management.

Another notable incident during the meetings was an address on "The Selection of Employees" by Dr. Katherine M. Blackford, which briefly sketched the study that is made of each man's personality before he is hired by the Rumely Company, in order that he may be assigned to the work for which he is best suited. Among the nine characteristics which are examined is that of color. As an illustration Dr. Blackford noted that on the Pittsburgh & Lake Erie the chief despatcher was a brunette, and upon inquiry found that blondes were seldom employed in that capacity, the present staff on that road being composed entirely of brunettes, except for one red head. Other characteristics examined are size; shape of profile of head; structure; consistency; expression as shown by voice, gesture, walk, clothing, etc.; proportion as to energy, vitality and endurance; experience; and texture or quality, i. e., fine or coarse. Men should be so selected as to harmonize with the job and the characteristics of the boss. Necessarily Dr. Blackford could only cover the subject superficially, although a speaker at a later session mentioned a book on the subject by Dr. Blackford which may shortly be issued. Altogether the meeting proved to be a great success, and the example of the Western Economic Society should be followed by similar organizations in other parts of the country.

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GOVERNMENT REGULATION AND RAILROAD STANDARDS.

STATE regulation, as related to railroad service, implies an improvement of that service. It is on the expectation of more completely satisfying the reasonable demands of the public that legislators are induced to adopt regulating laws. Even the grafting legislator, when he prepares a "strike" bill, means to recommend something that will at least seem to better the service. If railroad service had always been first class, everywhere, the legislatures, no doubt, would have turned their attention to other things.

When the federal government, in 1893, by an Act which only clumsily fitted the situation, standardized the Janney car coupler and the Westinghouse air brake it improved railroad service; this by compelling dilatory companies to catch up with the more enterprising. The standardizing was accomplished indirectly, for the statute did not specify either of those two devices; but it was effective standardization, nevertheless. That law was justified only because it aimed to make the best practice the universal practice. The same may be said of the boiler inspection law of 1911. We are not prepared to say that the boiler inspectors are worth what they are costing—$200,000 a year—but no one can find fault with the fundamental principle of the law.

But a government, in following railroad standards, is not always so sure of doing the right thing. The question of what is the best railroad practice is not always found to be so clearly settled in advance. In Connecticut, last week, the engineer of the State Public Utilities Commission, reporting on a collision which occurred at Warehouse Point, January 10, recommended that enclosed disk signals be superseded by semaphores. This officer of the state would be able, no doubt, to quote the opinion of competent railway officers in support of this view. It would not be the first time that a state commission has gone too far, justifying itself in that way. But what we wish to point out is that the trouble at Warehouse Point was not ascribed to the type of signal. The report makes no suggestion that a semaphore would have been any better. The collision occurred at night, and at night semaphores and disks, for every practical purpose, are all the same. It may be admitted that semaphores are very generally favored by signal engineers; but this opinion is not universal, and large numbers of disk signals still give satisfactory service; why should the state lend its influence in favor of throwing away all the automatic signals on 60 miles of road? Quite likely the New Haven company could spend its money to better advantage on some section of road which has no block signals at all. No good purpose would be served, probably, by requiring state officers, reporting on accidents, to refrain entirely from making general observations concerning safety; but, surely, in going outside the subject in hand it is desirable to keep on very solid ground. (The real causes of this collision are given in another column.)

Another case where a government officer has acted on railroad officers' standards and in so doing has missed his point, is that of the collision at Dresden, Ohio, December 3, last, when 11 persons were killed. The inspector of the Interstate Commerce Commission, reporting on this case, says that the time interval between trains (passenger trains) should be more than five minutes. A passenger train was unexpectedly stopped, because of trouble with air brakes, and the flagman did not have time to get back far. This view is correct, if the time interval is to be used. If the interval were to be made 10 minutes or more, the government could get the indorsement of many railroad rule books. If it were made 20 or 30 minutes, universally, it could be plausibly recommended as a safe rule, with some exceptions. (The present recommendation does not say how much greater the time interval should be.) But the best railroad standard demands the use of the space interval; the time interval has been proved inadequate. Governmental authorities cannot fairly approve the time interval, simply because it has railroad approval. To merely lengthen the time interval is not making rational use of the lesson of those eleven deaths. The Interstate Commerce Commission has repeatedly recommended the use of the space interval system, because no other system is adequate; in issuing this report the commission ignores its own former declarations. The justification of governmental action in the matter of air brakes was that the railroads did not properly live up to their own best standards; the same consideration applies in the case of the block system.

In passing, it may be noted that the inspector follows another bad example, set by some railroad men, when he refers to the failure of the air pipe on the engine as one of the chief causes of the Dresden collision. That failure was not a cause at all; it was only the occasion. It caused the stoppage of the train; but what kind of a theory is that which makes it unsafe to stop a train? Where is the superintendent who is willing to ride over his own division unless he can feel perfectly safe in stopping at any place, at any time?

In one of these two reports, we see, the inspector went too far, and in the other not far enough; and with reputable railroad backing in both cases. In a third case, a collision at Bowerston, Ohio, December 13, the inspector of the Interstate Commerce Commission, attacking the flagging rule of the Pennsylvania Lines, sets out to say what a perfect flagging rule should be; but he stops at the end of the sixth line! (We shall not complain at brevity, *per se*, for those who go farther may fare worse.) The form criticised is that of the well known Rule 99, of the American Railway Association, which leaves everything to the judgment of the flagman. Says the report: "When considered in connection with safety in the movement of trains, the flagging rule is of paramount importance, and its requirements should be as absolute as it is possible to make them. It should be incapable of more than one construction, entirely free from uncertainty or indefiniteness, leaving no room for error of judgment by a flagman when such error may prove disastrous."

Here is a case where a state officer may well pause, for the rules of the railroad companies are of all sorts. If the United States government, or any power on earth, could frame a workable flagging rule, railroad officers surely would hail it with joy. But everybody knows that the beautiful ideal here outlined by Mr. Belnap has been striven after by innumerable committees, during the past 30 years, and that they have all given up in despair. A rule entirely free from indefiniteness, leaving no room for error of judgment, would either be (*a*) so long that half the brakemen could not be taught to comprehend it, or (*b*) would necessitate the employment of a half dozen flagmen on every train, and cause very frequent delays, to say nothing of the cost and the uncertainties of constant dependence on torpedoes and fusees. The conclusion of the American Railway Association, after years of discussion, that the flagman must be trusted to use his judgment, is a virtual confession that a complete and workable flagging rule cannot be made. The Association leaves every road free to amplify the rule to any extent desired, and many books do still specify distances and other details; but where is the superintendent who is satisfied with his rule, except under favorable circumstances and light traffic? This is not the first time that governmental authorities have attempted to give us a satisfactory flagging rule. The Louisiana State Railroad Commission recently prescribed a long one. But with the best rule ever written, the railroad officer who aims at a reasonable degree of safety—we will not say perfect safety—still finds himself left with many conditions not satisfactorily provided against; and he turns to the block system as the only escape from an impossible situation.

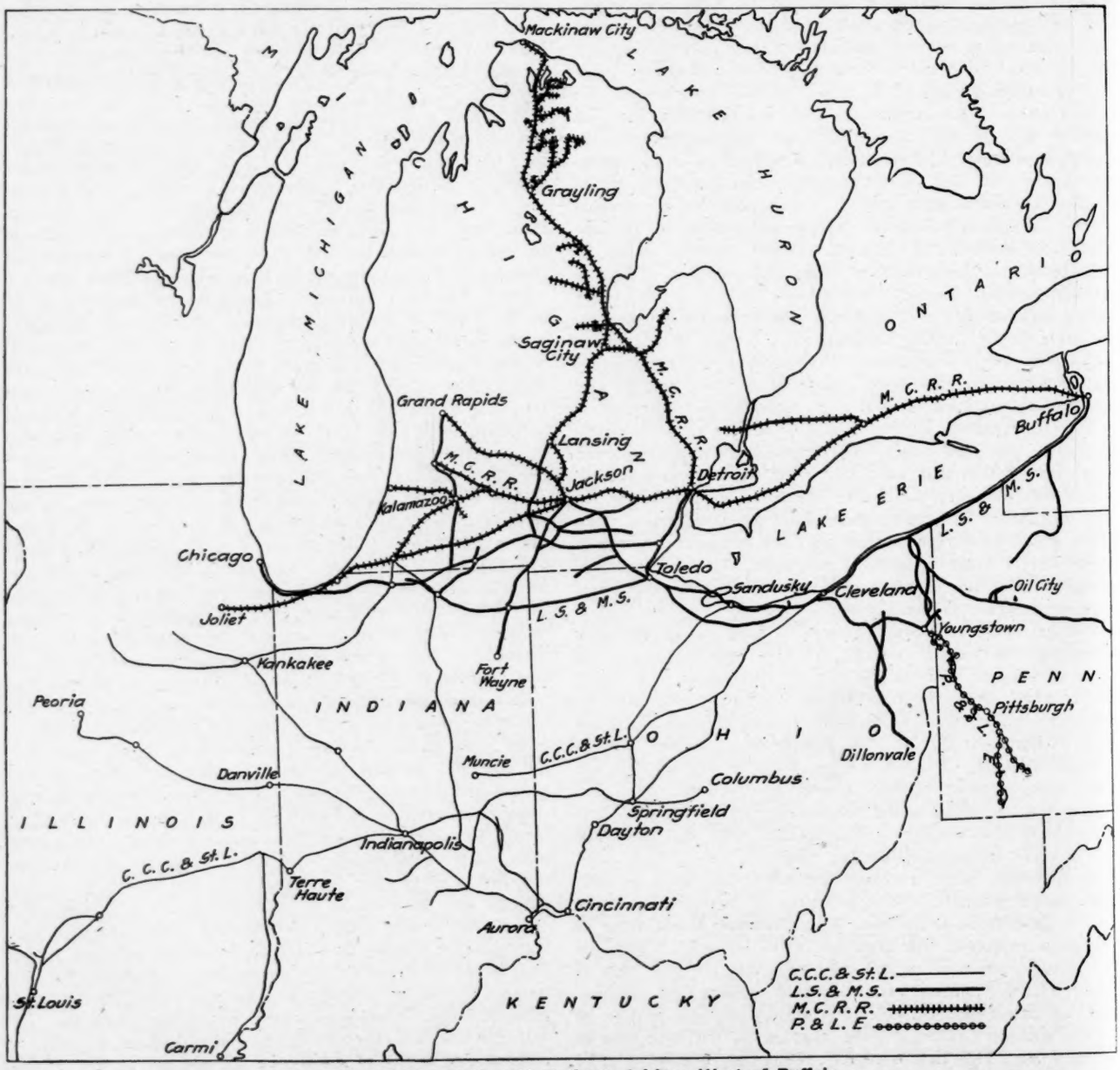
As we have already intimated, government can sometimes promote good railroading by prescribing the best standards of practice. This last report contains some salutary truths, forcibly expressed. But experience has taught that there is danger both of going too far and of not going far enough. When it comes to formulating a satisfactory flagging rule for general adoption there is a thirty years' history that cannot be ignored.

LAKE SHORE AND MICHIGAN SOUTHERN.

THE results of operation of the Lake Shore & Michigan Southern in 1912 are like a renewed pledge that earnings wisely turned back into a railroad property will, under good management, bear fruit in a reduction in *transportation* costs. In 1912 the cost of transportation, exclusive of any expenditures on the maintenance of property or equipment, per revenue ton mile moved was less by over 7 per cent. than in 1911. The Lake Shore carried the greatest amount of traffic in its history and earned a total from operation of $54,284,000, or 12.25 per cent. more than in 1911. Despite liberal increases in maintenance expenditures, the company had an operating income of $17,093,000 in 1912, as against $14,212,000 in 1911.

In a good many ways the Lake Shore & Michigan Southern is comparable to no other railroad in the United States. In natural advantages it is second to none. The company operates 1,872 miles of road, by far the greater part of which is main line, with almost no grades, through a territory in which fuel is cheap and where the nature of the traffic permits of very heavy car and train loading and of a comparatively small percentage of empty car mileage. These natural advantages account in part for the heavy train load, low operating ratio and great earning capacity of the Lake Shore when compared with other roads; but a decrease of 7 per cent. in transportation costs in 1912 as compared with 1911, in the face of an increase in labor costs, is the result of a policy of betterment from earnings that has been one of the characteristics of the management of the Lake Shore for a good many years.

A heavy expenditure for betterment of railroad property will often appear to have little, if any, direct effect in reducing transportation costs as long as the volume of traffic remains the same. When, however, the volume of traffic shows a material increase, as was the case in 1912 on the Lake Shore, the real advantages of former expenditures become apparent. In 1912 the Lake Shore carried 41,081,000 tons of revenue freight, which is more by 6,194,000 than was carried in 1911. The average haul was 167 miles in each year, so that the ton mileage totaled 6,874,000,000 in 1912, as against 5,841,000,000 in 1911. The Lake Shore has a freight traffic density of 3,813,000 tons carried one mile per mile of road. In addition to this quite remarkable freight density, the road



The Three Principal New York Central Lines West of Buffalo.

carried 402,000 revenue passengers one mile per mile of road.

Of the total 41,082,000 tons of freight, bituminous coal furnished 10,807,000 tons; ores, 5,621,000 tons; and stone, sand and like articles, 4,048,000 tons. The increase in the tonnage of these three commodities was for bituminous coal, 1,695,000 tons; for ores, 917,000 tons; and for stone, etc., 890,000 tons. The Lake Shore furnishes a good example of how profitable it is on most roads to carry a large proportion of low grade freight which, although it takes a low ton mile rate, permits of large economies in cost of handling. The Lake Shore can almost be compared with the Delaware, Lackawanna & Western as a net revenue earner; but whereas the Lackawanna gets an average ton mile rate of well over 7 mills per ton per mile, the Lake Shore gets but 5.29 mills. This was the average in 1912 and was only slightly lower than the 1911 average.

The operating ratio in 1912 was 65.46 per cent. as compared with 67.09 per cent. in 1911. There was spent for maintenance of way and structures 12 per cent. of total operating revenues in 1912 and 12.79 per cent. in 1911; for maintenance of equipment, 17.11 per cent. in 1912 and 16.69 per cent. in 1911; for traffic expenses, 1.77 per cent. in 1912 and 2.12 per cent. in 1911; and for general expenses, 1.79 per cent. in 1912 and 1.91 per cent. in 1911. Transportation expenses consumed but 32.79 per cent. of total operating revenues in 1912, as against 33.58 per cent. in 1911.

A good indication of how the company was able to reduce its transportation costs by 7 per cent. is afforded by a comparison of equipment mileage and car and train loading figures. The train load of revenue freight in 1912 was 693 tons, as against 635 tons in 1911, and the total train load, including company freight, which is an even better criterion of operating conditions, was 731 tons in 1912, as against 666 tons in 1911. Another way of stating the same thing is that while ton mileage increased by over 17 per cent., freight train mileage increased only 7.81 per cent., and freight locomotive mileage increased less than 7 per cent. With an increase in passengers carried one mile of a little over 1 per cent., the mileage of passenger locomotives showed a decrease, which although slight in itself is remarkable, in that the majority of other roads showed increases in 1912 in passenger train mileage quite out of proportion to the increases in passengers carried one mile.

Nearly all of the common stock of the Lake Shore & Michigan Southern is owned by the New York Central & Hudson River and deposited under Lake Shore collateral trust bonds. The 18 per cent. dividend, amounting to $8,904,000, which was paid by the Lake Shore both in 1912 and 1911, figures as "other income" on the New York Central's income statement. Whereas, however, the parent company had less than 2 per cent. surplus on its stock after paying 6 per cent. dividends to its stockholders, the Lake Shore had a surplus in 1912 of $7,584,000, or 15 per cent., on its own stock, and this surplus is properly an equity for New York Central stockholders.

In 1912 the Lake Shore spent $3,239,000 for additions and betterments and added net to its equipment $2,178,000, although as a matter of bookkeeping it credited road and equipment account with $1,506,000 for equipment trust installments paid in 1907, 1910 and 1912. The Lake Shore's balance sheet makes a very strong showing. With working liabilities amounting to $18,916,000, there are working assets of $134,332,000. The very strength of the showing possibly indicates that at no very distant future time the company hopes and expects to do some permanent financing. Included in working liabilities are $11,648,000 one-year notes, part of which fell due on February 24 of this year and part on March 2. The notes were temporarily refinanced by the sale last week to J. P. Morgan & Company of $12,000,000 one-year 4½ per cent. notes. The Lake Shore's credit is so high that it can get short term loans on very reasonable terms and can therefore well afford to wait for permanent financing until the bond market is to the liking of its bankers. One-year notes, however, are probably only a temporary expedient even for a road with credit like the Lake Shore. Included in working assets are $107,119,000 marketable securities and $9,329,000 loans and bills receivable from subsidiary or affiliated companies. Cash on hand at the end of 1912 amounted to $6,235,000.

The following table shows the principal figures of operation in 1912 as compared with 1911:

	1912.	1911.
Average mileage operated	1,872	1,775
Freight revenue	$36,371,244	$31,101,335
Passenger revenue	11,835,199	11,350,096
Total operating revenues	54,283,617	48,360,997
Maint. of way and structures	6,516,212	6,178,623
Maint. of equipment	9,283,833	8,069,393
Traffic expenses	961,762	1,026,317
Transportation expenses	17,797,334	16,245,052
General expenses	975,504	924,489
Total operating expenses	35,534,644	32,443,875
Taxes	1,771,098	1,673,940
Operating income	17,093,279	14,212,105
Gross income	27,442,055	24,496,694
Net income	16,584,384	14,268,365
Dividends	9,000,000	9,000,000
Surplus	7,584,384	5,269,365

MICHIGAN CENTRAL.

LIKE the Lake Shore & Michigan Southern, although, of course, on a smaller scale, the Michigan Central had a substantially larger surplus after the payment of dividends in 1912 than in 1911. After the payment of 6 per cent. dividends in 1912 there was a surplus of $1,602,000, or $610,000 more than the surplus in 1911 after the payment of the same dividends. As in the case of the Lake Shore, this surplus forms in large part an equity for stockholders of the New York Central & Hudson River.

The Michigan Central operates 1,817 miles of road. The greater part of its stock is owned by the New York Central & Hudson River, and its lines form the northern part of the New York Central Lines west of Buffalo. While its main line between Buffalo and Chicago has a heavy density of both passengers and freight, a considerable portion of its mileage runs up into the State of Michigan, where traffic is comparatively light. The average ton miles per mile of road amounted to 1,794,000 in 1912, and to 1,701,000 in 1911, and passenger miles per mile of road amounted to 233,000 in 1912, and 220,000 in 1911. No such large preponderances of total tonnage carried is bituminous coal, ores and stone on the Michigan Central as on the Lake Shore. The total tonnage of revenue freight carried in 1912 was 21,100,000, as against 18,729,000 in 1911, and of this total tonnage in 1912, 3,893,000 tons were bituminous coal and 2,105,000 tons were stone, sand and like articles. The bituminous coal tonnage showed an increase over 1911 of 601,000 tons, and the stone of 318,000 tons.

The M. C. carries a quite large tonnage of products of agriculture, grain alone furnishing, in 1912, 1,235,000 tons. A large tonnage of manufactures is carried consisting of a great variety of articles, the movement of the greater number of which is, of course, intimately connected with the prosperity of the country served. Manufactures other than those usually listed separately, such as petroleum, sugar, iron, agricultural implements, household goods, etc., amounted to 2,672,000 tons in 1912, an increase over 1911 of 356,000 tons. The generally prosperous condition of the country is not reflected, however, in increased local passenger business. The total number of interline passengers amounted to 1,214,000, an increase of 150,000 over 1911; but local passengers decreased in number, as did also commutation passengers, so that the total number of revenue passengers carried amounted in 1912 to 6,000,000, or only about 1 per cent. more than was carried in 1911.

Total operating revenues amounted to $32,912,000 in 1912, an increase of $2,747,000 over 1911. Operating expenses did not mount up in quite the same proportion as revenues, so that the operating ratio in 1912 was 69.91, as compared with 70.76 in 1911. Total expenses amounted to $23,009,000, an increase over the

previous year of $1,663,000. The following table shows the ratio of each class of expenses to total operating revenue:

	1912.	1911.
Maintenance of way and structures	11.03	11.77
Maintenance of equipment	14.32	14.58
Traffic expenses	2.32	2.60
Transportation expenses	40.45	39.94
General expenses	1.79	1.87

Only very slightly more was spent for maintenance of way in 1912 than in 1911, and this increase was entirely accounted for by larger track forces at higher wages. Total maintenance of way cost $3,630,000 in 1912, which is $81,000 more than was spent in 1911. This includes the expenditure for roadway and track, which is largely made up of the cost of track labor, and amounted in 1912 to $1,411,000, as against $1,177,000 in 1911. The annual report does not make it entirely clear as to why so much smaller sums are shown as having been spent for ties and rails. In 1912 the expenditure for ties was $595,000, or $234,000 less than in 1911, and the expenditure for rails was $86,000, or $133,000 less than in 1911. President Brown, in his comments, mentions the decreased prices in rails and ties. The detailed figures accompanying Mr. Brown's report show that a greater tonnage of 100-lb. rail was laid in 1912 than in 1911, and that more ties were put in track in 1912 than in 1911. The average price per ton of rail is given at 31.17 in 1912 and at 30.22 in 1911, and the average price of ties at distributing points at 71 cents in 1912 and 68 cents in 1911.

Maintenance of equipment cost $4,712,000 in 1912, or $312,000 more than in 1911; and although steam locomotives averaged 34,152 miles apiece in 1912, as against 32,588 miles in 1911, repairs per locomotive mile cost 7.08 cents in 1912 and 6.11 cents in 1911.

The Michigan Central, with its higher grade traffic, has no such heavy train load as the Lake Shore, but with the increases in tonnage of various commodities was able to show a revenue train load of 455 tons in 1912, as compared with 424 tons in 1911 The gain in train loading was entirely in revenue freight, company freight averaging one ton less per train. Not only did car loading increase (from 15.71 tons per loaded car in 1911 to 16.52 tons in 1912), but there was a notable reduction in empty car mileage. Total freight car mileage amounted to 271,478,000 miles in 1912, and of this total mileage, 194,513,000 was made by loaded cars, an increase over 1911 of 692,000 car miles, and 70,202,000 was made by empty cars, a decrease of 10,513,000 car miles. The very considerably heavier ton mileage was handled with 8,127,000 freight locomotive miles, which is less by 69,000 than the locomotive mileage in 1911.

The balance sheet of the Michigan Central at the end of 1912 showed cash on hand of $3,201,000, comparing with $3,311,000 at the end of 1911. Loans and bills payable remained the same throughout the year, namely, $4,500,000. The Michigan Central is not a heavily capitalized property, and although it used its credit to help finance the Detroit river tunnels and to guarantee the principal and interest of Canada Southern 50-year 5 per cent. bonds, of which $22,500,000 have been issued, it should under favorable bond market conditions not have any trouble in permanently financing its loans and bills payable.

The following table shows the principal figures for operation in 1912, as compared with 1911:

	1912.	1911.
Average mileage operated	1,817	1,817
Freight revenue	$21,218,205	$19,538,604
Passenger revenue	8,250,336	7,607,052
Total operating revenues	32,580,853	29,872,566
Maint. of way and structures	3,629,732	3,549,205
Maint. of equipment	4,711,843	4,400,291
Traffic expenses	764,733	783,599
Transportation expenses	13,313,059	12,049,103
General expenses	5,859,388	563,552
Total operating expenses	23,008,756	21,345,755
Taxes	1,366,985	1,322,621
Operating income	8,564,111	7,505,023
Gross income	9,624,774	8,675,980
Net income	2,726,333	2,116,364
Dividends	1,124,280	1,124,280
Surplus	1,602,053	992,084

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.

COINCIDING as it does with the demands of the firemen for higher wages now being heard before the arbitration committee, the publication of the annual report of the Cleveland, Cincinnati, Chicago & St. Louis for the calendar year 1912 gives a bit of unpremeditated evidence that is rather interesting. Total expenses on the Big Four were $1,674,000 more in 1912 than in 1911. Of this increase, $1,049,000 was due to increases in the payrolls in the maintenance and transportation departments.

The Big Four did a record business in 1912. Its total earnings amounted to $32,714,000, an increase over 1911 of $2,282,000. The road (2,012 miles operated) carried 4,084,231,000 revenue ton miles, an increase over 1911 of 458,864,000. Passenger revenue and business were somewhat smaller in 1912 than in 1911, but only about a quarter of the total operating revenues of the C. C. C. & St. L. are furnished by passenger revenue. With the increases in traffic handled, an increase of $1,674,000 in expenses is not excessive. The operating ratio on the Big Four is high, but was slightly less in 1912 than in 1911. It was 74.46 per cent. last year and 74.55 per cent. the year before. The increase in expenses, due to larger payments to employees, seems out of proportion to the total increase in expenses.

The C. C. C. & St. L. is controlled by the New York Central & Hudson River. It competes with the Pennsylvania Lines West and, as will be seen from the map published with the comments on the Lake Shore & Michigan Southern's annual report, its lines have somewhat the characteristics of a network. It is probably largely due to the fact that it has so much larger proportion of what may be called branch line mileage that its operating ratio is so much higher than that of the Lake Shore.

The Big Four carries a large proportion of low grade traffic, and while it gets a low average ton mile rate—5.43 mills in 1912—this is true also of the Lake Shore. Of the total tonnage carried, which amounted in 1912 to 25,817,000 tons, 11,139,000 tons were bituminous coal and 1,548,000 tons were stone, sand and like articles.

The class of expenses that seems high when compared with the Lake Shore transportation expenses. The following table shows the per cent. of total operating revenue that was consumed by each class of operating expense in the years 1912 and 1911:

	1912.	1911.
Maintenance of way and structures	11.97	11.07
Maintenance of equipment	17.95	17.81
Traffic expenses	2.63	3.00
Transportation expenses	39.84	40.40
General expenses	2.07	2.27

The revenue trainload on the Big Four increased from an average of 445 tons in 1911 to 474 tons in 1912. Car loading was better by about 5 per cent. The average number of tons of all freight per loaded car was 21.3 in 1912, and 20.2 in 1911. While there was a large decrease in empty mileage, there was an even larger increase in loaded car mileage, so that notwithstanding the heavier train load, the mileage of freight trains increased from 8,105,000 in 1911 to 8,580,000 in 1912. Loaded freight car mileage last year totaled 201,578,000, an increase over 1911 of 11,877,000; and empty freight car mileage amounted to 79,329,000 in 1912, a decrease from 1911 of 10,714,000.

The Big Four is not a heavily capitalized road. The total stock and bonds outstanding average about $72,400 per mile of road operated; but it is paying dividends only on its preferred stock, which totals $10,000,000, calling for $500,000 in dividends. There is $47,056,000 common stock outstanding which is receiving no dividends. After the payment of 5 per cent. on its preferred, the C. C. C. & St. L. had a surplus in 1912 of $1,844,000, as against $1,302,000, the corresponding surplus in 1911. The company readjusted through its profit and loss account its general balance sheet statement so as to correspond to the requirements of the Interstate Commerce Commission, and in so doing debited profit and loss with $1,385,000 for property abandoned from 1905 to 1912 inclusive. The company spent and charged

to capital account $1,395,000 for additions and betterments to roadway and structures and $2,782,000 for new equipment, crediting the equipment account, however, with $1,129,000 for equipment trust instalments paid in 1907, 1910 and 1912, and for the balance in the equipment replacement fund. At the end of 1912 the company had on hand $3,537,000 cash, with total working assets of $10,573,000, and working liabilities of $8,235,000, of which $2,745,000 was loans and bills payable.

The following table shows the principal figures for operation in 1911 and 1912:

	1912.	1911.
Average mileage operated	2,012	2,012
Freight revenue	$22,168,002	$19,933,296
Passenger revenue	7,778,136	7,819,255
Total operating revenues	32,714,238	30,431,915
Maint. of way and structures	3,915,421	3,370,476
Maint. of equipment	5,872,422	5,418,645
Traffic expenses	860,666	912,751
Transportation expenses	13,033,333	12,293,691
General expenses	677,902	690,144
Total operating expenses	24,359,745	22,685,708
Taxes	1,190,243	1,062,512
Operating income	7,135,769	6,637,608
Gross income	7,892,577	7,345,340
Net income	2,344,352	1,801,616
Dividends	500,000	500,000
Surplus	1,844,352	1,301,616

NEW BOOKS.

Car Builders' Dictionary. 1912 (Seventh) Edition. Compiled and edited for the Master Car Builders' Association by Roy V. Wright, managing editor of the *Railway Age Gazette* and editor of the *American Engineer*, assisted by Andrew C. Loudon. Illustrated. 953 pages, 9 in. x 12 in. Published by the Simmons-Boardman Publishing Company, New York, and distributed by the McGraw-Hill Book Company, 239 West 39th street, New York. Price, leather bound, $6; cloth bound, $4.

This dictionary is too well known to require any description. The new edition cannot be properly designated as a revision of the last edition, since it is to all intents and purposes an entirely new book. The progress in car design and construction has been so great during the past three years that a large part of the illustrated section of the 1909 edition was found to be obsolete.

The designs illustrated in the present edition have been most carefully selected and represent approved modern practice in every particular. The smaller and lighter equipment has by no means been overlooked, but recent improved designs have been chosen as examples. The utmost care has been used to make the book complete and to cover the full range of rolling stock. This has resulted in a material increase in the size of the volume, in spite of the fact that the machine tool section given in the previous edition has been eliminated. The drawings are fully dimensioned, and all of the more important details are shown separately. Cross references giving the location of the drawings of associated parts accompany many of the captions and are one of the new features which will be fully appreciated. One of the most valuable parts of the book is that containing the standards of the Master Car Builders' Association, which are given complete, and in each case have been redrawn on a larger scale, making them much more legible than those furnished by the association.

In the definition section, all of the new terms that have come in general use during the past few years have been included, and their meaning made clear. Definitions of other terms have been completely revised, and in many cases entirely reworded. Among the new features are the complete details and specifications for postal cars as required by the United States government. The section on electric motor cars has been greatly extended, and an entirely new section on wrecking equipment and tools has been added. Typographically the book presents a much more pleasing appearance than former editions, and the reproduction of the photographs in the book is particularly well executed.

Letters to the Editor.

JAMES J. HILL'S STATISTICS.

BALTIMORE, Md., March 15, 1913.

TO THE EDITOR OF THE RAILWAY AGE GAZETTE:

Will you give me space to correct a momentary aberration?

In a letter which you were good enough to publish for me in your issue of March 14, in relation to Mr. Cunningham's criticism of James J. Hill's statistics, I made the statement that "all incomes are from 50 to more than 100 per cent. lower in Europe than here." Obviously this is an incorrect statement. What I intended to say was that "all incomes are from 50 to 75 per cent. lower in Europe than here." I may add that the statement has received very recent confirmation in so far as it applies to Germany in a statement by Dr. Gustav Stresemann in the *Manufacturers Record* of February 27. Dr. Stresemann says "the purchasing power of the dollar is scarce more than 2 to 2½ marks." This would make the scale for Germany from about 40 to 53 per cent. lower than income and prices in the United States. As Germany pays higher wages than the majority of the countries on the continent of Europe, it will be seen that my statement, as I intended to make it, is fully supported by quite recent evidence from Germany.

M. B. WILD,
Statistician, Baltimore & Ohio.

DEFLECTABLE HEADLIGHT.

CHICAGO, Ill., March 3, 1913.

TO THE EDITOR OF THE RAILWAY AGE GAZETTE:

In your issue of February 28, 1913, W. F. Schaphorst sets forth the need of a deflectable headlight to illuminate the right of way on curves. Such a device was developed on the Missouri, Kansas & Texas, two years ago by J. R. Pratt, electrician, in which the parabolic reflector is revolved through a slight angle about a vertical axis passing through the focal center of the reflector. The reflector is operated by the engineer in the cab pulling a small lever which connects through a system of rods to the headlight. The headlight casing itself is in no way affected, the parabolic reflector shell alone moving. Since the reflector is revolved about its own focal center, there will be no change in the effectiveness of the beam of light as deflected on rounding a curve.

This design has been used to some extent on the M. K. & T., and is very popular with the locomotive engineers themselves.

EDWARD WRAY,
Publisher, *Railway Electrical Engineer.*

MORE PUBLICITY.

CHICAGO, March 8, 1913.

TO THE EDITOR OF THE RAILWAY AGE GAZETTE:

Railroad men quite generally appreciate the value of the right sort of publicity. It has often seemed to me that they have long overlooked an opportunity for effective publicity, especially in the smaller communities. Any traveler who has had occasion to wait for a train in a station situated in a town of 5,000 people or less has probably read and reread the few flyspecked and age-worn public notices that adorn the walls of the waiting room. Occasionally a picture may be found in the better class of stations, and at rare intervals some special advertising matter may be in evidence. As a general proposition, however, the traveler who has no book or paper to read is confronted with the necessity of passing the time before the arrival of his train, in idleness.

There are four classes of people that may be found in the waiting room at such a time, the loafer down to see the train go through; the townspeople who are there to meet friends; the professional traveler, and the casual traveler. At a time such as this in a station of the character previously indicated, an oppor-

tunity is presented to the railroad company to make a specific advertising appeal to at least three of the four groups previously suggested. The value of such an opportunity has been recognized in other lines of business. The practice of calling the attention of the customer to particular features that may be of mutual interest is universally followed in the better classes of merchandising establishments. Particularly, increasing emphasis is placed upon the character of the service offered.

It would seem that a weekly bulletin service would constitute a comparatively inexpensive, but entirely adequate, method of utilizing this opportunity. An attractively designed and printed bulletin placed upon the wall of the waiting room upon which appeared a number of items of general interest pointedly stated could be made a most effective factor in the interest of the right kind of publicity. Upon this bulletin attention could be called to improvements in service, records in safety, traffic handled, expenditures to make facilities more adequate and other features pertaining to the railroad company which would be of interest and a matter of local pride to the people of each community. Such a bulletin service could also be made of value in calling attention to sectional needs in an agricultural, commercial and industrial way. It would also afford an opportunity for pressing home to the reader each week that the business of the company was to serve his interests in every possible manner. A high standard of service is, of course, the first and most essential factor in the relation of the railroad to the public. A persistent policy of tactfully calling attention to various features of the service is equally important. Persistent repetition of even self-evident facts has a definite advertising value. A bulletin service of the type suggested would afford a convenient and comparatively inexpensive method of accomplishing this result.

The expense connected with such a service would be very nominal as compared with many forms of advertising which are very commonly employed. The three items of expense would be, a writer to produce the copy—this is not office boy work—the expense of printing the bulletins and the expense incident to the distribution of them.

In summary there are three essential considerations with reference to this suggestion: (1) a large number of people in a receptive mood, (2) an abundance of interest and valuable data for company customers, (3) an advertising medium that has the merit of comparatively slight expense.

Such a service would be welcome to at least one casual traveler.

George A. Clark.

PRIZES FOR ALERTNESS.

Buffalo, N. Y., March 18, 1913.

To the Editor of the Railway Age Gazette:

I have read with much interest your article, in the last issue, on the order which has been promulgated on the Pennsylvania Railroad instructing passenger trainmen to freely convey information to passengers; and particularly with your suggestion that where this information has to come through the office of the despatcher everybody interested ought to be on the alert to receive and give out information in the shortest possible time.

Why would it not be a good plan to give "merits" for quick action in matters of this kind? This could be done in the same way that some of the roads, where the Brown system of discipline is in effect, give station men and others commendatory notices when they discover a broken wheel or a loose brake-beam. Or, to make the matter more business-like, why not offer a definite prize, perhaps only a small one, to be awarded every six months to the despatcher or station agent or conductor, who makes the best showing of alertness in this matter?

I recall that on some road in Indiana, I think it was the Wabash, some time ago, mention was made of how, by a little friendly rivalry between crews, the time taken to gather a wrecking crew and start out a derrick car had been very greatly reduced. If men take pride in thus clearing the road when it is obstructed, why can we not also school ourselves to take pride in clearing up passengers' troubles, when they are anxious because of a blockade on the line?

G. H. M.

SEE AMERICA FIRST?

Philadelphia, January 20, 1913.

To the Editor of the Railway Age Gazette:

Your request, some time since, for my views on the subject of "See America First," has not been overlooked, but this is my first opportunity.

Undoubtedly the novelty of a sea voyage and the sight of foreign lands is a strong attraction to the would-be traveler, with money to spend, for his first trip; and it is not so strange that his patriotism should succumb, especially after hearing what his more experienced friends can tell him of comparative costs. But just at this point patriotism succumbs a second and many more times. Europe affords many districts where one can find more than enough to interest him for all summer, with but a few miles of railroading, and almost every night one may rest comfortably in a clean bed, after a well cooked and carefully served dinner, and all for a very modest price. Great hotels in great cities are much the same the world over; but rarely in this country can one find real comfort devoid of extravagant elegance, or for a moderate price.

And the question of railroad comfort is not so one-sided as is often asserted. The American is quite likely to look with scorn on European railroads and their methods, but let him learn those methods, fit his ways to them, and he will find an ease and comfort of travel which cannot be surpassed in this country, if it is often equaled.

Another point of no little moment in the life in Europe is the generally greater respect shown for law and order. (I have always been most deeply impressed, on my return to this country, by its absence.) I have never found even German police regulations oppressive, but on the other hand, have felt a calm comfort in joining in the uniform obedience, for the common good. City street traffic affords an ample field for observation on this point. After all, there is little difference in the habit of mind which sends the careless teamster past the traffic officer's raised arm at a crowded crossing, and that which sends a locomotive engineer past a stop signal. Both are more frequent in this country than in Europe.

The difficulty lies deeper than the individual; it lies in the laxity of public opinion, which is ready to excuse and condone the invitation provided disaster does not accept it.

Another element which affords much comfort and pleasure to the traveler in Europe, and the frequent lack of which causes much discomfort here, is the cheapest thing in the world—courtesy. That it is often superficial makes it no less effective, and the film, however thin, is vastly better than none at all. The hotel manager who, at our departure, came to our cab door, bowing his thanks for our patronage, and presenting Mrs. Busch with a bouquet of roses, left with us a sense of pleasure and a desire to return, which I have never experienced on leaving any hotel in this country. Many Americans will laugh at this excess, but it is very pleasant; and it pays, as the transatlantic passenger lists will show.

A German gentleman whom I met last summer, said one morning, as we were steaming up a Norwegian fjord: "Tell me why I should go to your country; what more can I see there? My home is in Mannheim. In two hours and for a few marks I can be in Switzerland; or, it is not so much further to this northern country, where I can live well for six kröner ($1.27) a day. I know you will tell of your great cities, but I mean apart from them; I am thinking of a place to spend my vacation pleasantly. The Yellowstone? How far? What would it cost? Five hundred marks and more for railroad alone from New York there and back. Think what I can do for that sum here. Why should I go? What can I see there? Tell me."

I was at a loss. What answer would convince him that he should see America at all?

Henry Paul Busch.

STUDIES OF OPERATION—THE B. R. & P.

Increased Transportation Costs Per Gross Ton Mile Offset by Moving Traffic in Such a Way as to Get Competitive Business.

By William E. Hooper,
Associate Editor *Railway Age Gazette.*

The Buffalo, Rochester & Pittsburgh is an independent road in highly competitive territory with an excellent credit, operating about 569 miles, with a heavy freight traffic density and a fairly large passenger business. The fact that it is independent, in highly competitive territory, and being very successfully managed, indicates that a highly efficient organization must have been developed and most progressive policies must have been adopted.

If we study any large railroad system like the Chicago, Rock Island & Pacific, or the Pennsylvania as a whole, we get a great number of averages which are the result of any number of variables, each variable being in many cases itself an unweighted average. Weather conditions, material costs, labor costs, traffic conditions, standards of operation, all are radically different in Minnesota and in Texas. The Buffalo, Rochester & Pittsburgh is, in respect to operating conditions, a unit, and a study of these conditions has the further advantage that the B. R. & P. does not have its problems and its conditions of traffic forced on it by some outside considerations which have little, if anything, to do with that particular property. Its problems and conditions are those of an individual, not of some incomplete part of an individual.

The road is divided into four main line divisions, the Rochester division from Rochester to Ashford, the Buffalo division from Buffalo to Salamanca, the Middle Division from Salamanca to DuBois, and the Pittsburgh Division from DuBois to Butler Junction, including joint tracks to Pittsburgh and New Castle, at each of which points independent freight terminals are maintained.

Until eight or ten years ago the road depended almost entirely on coal tonnage, but notwithstanding the fact that the B. R. & P. has to meet competition of strong lines both for through and local business on nearly the entire length of its line, a very good business in general freight traffic other than coal has been built up. At the end of 1912 more than 50 per cent. of its earnings was from sources other than the transportation of coal, and more than 50,000,000 passengers were carried one mile, the passenger revenues alone amounting to over 11 per cent. of the total revenue from all sources. The B. R. & P. has had to depend, for its development of passenger and general freight traffic, largely on the quality of service which it can offer to shippers and travelers. Under circumstances such as these, the efficiency of operation cannot be judged solely, or in fact primarily, on the reduction in operating costs. The B. R. & P. itself figures that it loses 5.42 mills per mile on each passenger that it carries. As a matter of fact it probably makes money on its passenger business as well as on its freight business, but in both branches if the B. R. & P. is to handle the business at all, quality of service must be the first consideration. The study of operation of this road then divides itself into an exposition of operating methods and an analysis of costs.

To develop service that will be satisfactory to both the shipper and the traveler, and to perform this service economically, it is first of all necessary that all departments of the road act in close conjunction with each other. In other words an organization must be developed which will act as a unit. The word unit has become associated with divisional organizations; the B. R. & P., however, is organized on a strictly departmental basis.

All of the general officers report directly to the president, and acting as a board of management, it results in a compact, thoroughly competent and thoroughly loyal unit whose energies have been directed with extraordinarily good results toward the solution of a rather difficult problem. It is not intended to go into a discussion here of the financial results that have been obtained on the Buffalo, Rochester & Pittsburgh. It is sufficient to say that in the fiscal year ended June 30, 1912, the company earned $1,770,895 after the payment of all fixed charges, and was able to increase its dividend from an annual 5 per cent. to 6 per cent. A study of how these results have been obtained is a study of innumerable details; each detail, however, attacked along certain definite lines. It is impossible to *define* the principle that has governed this development. It is possible, however, to suggest these principles by describing the way certain particular problems are handled.

Coal and coke traffic originates on branch lines joining the main line near Indiana Junction and DuBois. The greater part of this traffic moves north to Rochester, where it is either shipped to Canada and St. Lawrence river territory via Lake Ontario or turned over to connecting eastern lines. Trains are moved solid from these junctions to Salamanca yards, and since the B. R. & P. is not a low grade line, a great deal of double-heading is necessary. The greater part of the coal and coke equipment sent north loaded returns south empty, and of course, it is necessary for power used in double-heading to be sent south under light rating. Furthermore, the empty cars must be distributed to the mines promptly and on the proper basis. Since almost the entire merchandise and manufacturers' business is highly competitive, this business must be moved promptly; but here again the most important factor in getting the business lies in having equipment available at once at the points where it is wanted.

It will be seen, therefore, that there are two factors which must be considered in determining expenditures for power, schedules for freight trains, etc. The nature of traffic permits of heavy loading, while the exigencies of the traffic and of competition necessitate prompt movement. Furthermore, it is not considered as expensive to send power south that is able to maintain a fairly high speed with light rating as it would be to send heavier power south with a light rating that would not permit of as rapid movement. In other words, the Buffalo, Rochester & Pittsburgh has a traffic and a profile northbound that would suggest the use of Mallet locomotives, but other conditions modify the situation to such an extent that Mikado locomotives are being used on the heavier grades and in pusher service, displacing lighter power. On the heavier grades, where a Mikado is used in pusher service, it is taking the place of two consolidation locomotives, so that now a consolidation and a Mikado are used where previously three consolidations were used.

The object aimed at in passenger traffic development is to afford comfort rather than speed, this same tendency is consistently carried out in all expenditures made on account of the passenger department. It is safe to say that little, if any, additional expenditure is put into maintenance of roadbed to provide for high speed passenger trains, while on the other hand a considerable amount of money is being spent for passenger stations that are comfortable and attractive for the towns in which they are built. In this regard a detail of passenger operation is worth mentioning. Cafe cars are being operated on local passenger trains. It is a rather interesting experiment, and is mentioned here because it is an indication of how particular

operating problems are being met and because the fact that a cafe car is being carried on local trains has a decided effect on the cost of operation.

It has already been suggested that the measure of the efficiency of operation in the freight department is the promptness and adequacy of car distribution. The method of keeping track of this car distribution and of the movement of loaded and empty cars on the line is not different materially from that in use on quite a number of other lines. On its face it is the ways in which the ordinary methods of operation are used rather than the methods themselves that are of special interest. A situation report, such as is made up at 6 a. m. and 6 p. m. on the B. R. & P., is shown herewith. The situation report, of course, goes to the general manager, superintendents, superintendent of car service, trainmasters and despatchers, and also goes to the president. In addition to this situation report, there are six other important reports that are used by the despatchers, trainmasters and superintendent of car service.

It may be said that these six other reports are elaborations of the report on the situation. This report tells what has been done the day before and what has to be done during the next succeeding 12 hours. The other reports show what cars are available to do this work, and it is through the manipulation of these cars that the despatchers and the superintendents do their most important work. The situation is further complicated by the fact that the B. R. & P. is an originating road, nearly 90 per cent. of the total traffic carried originating on its own lines and a very large percentage of this traffic being shipped off the lines.

Since 1908, up to and including the entire calendar year 1912, the B. R. & P. has supplied its coal shippers with 100 per cent. of their requirements for cars. This is not an average situation; that is, the shipper has not received eventually 100 per cent. of his requirements—he has received it day by day, even during the period of rather severe car shortage in the latter part of 1912. In 1909 1,244,946,097 ton miles and 44,914,997 passenger miles were carried, and in 1912 1,704,307,001 ton miles and 51,101,188 passenger miles were carried. To obtain this result, one or both of two things must have taken place. Facilities have been increased or the organization has been perfected so as to make materially greater use of the same facilities, or—and this is what has actually happened—there has been some increase of facilities with a marked increase in the efficiency of their use.

In 1909 $560,630 was spent for additions and betterments to roadway, and all of these may properly be charged to additional facilities for use of the transportation department; in 1910 $906,496 was spent for additions and betterments, of which $824,081 may properly be charged for new facilities for the transportation department; in 1911 $1,117,282 was spent for additions and betterments, of which $1,045,724 was properly chargeable to improved facilities for the transportation department; and in 1912 $633,664 was spent for additions and betterments, of which $556,111 was properly chargeable to increased facilities for the transportation department. It has been the practice of the B. R. & P. to make special appropriations each year from income to the sinking fund under equipment agreements, a portion of which is used for the purchase of new rolling stock, and the balance to retire a part of the equipment truts bonds falling due each year. These appropriations amounted to $315,000 in 1910, $371,500 in 1911 and $375,000 in 1912. Further there was a net addition of $2,820,438 to the equipment account provided for from current assets and the issuance of equipment bonds. This is a total of $2,986,546 spent on roadway and track and $3,195,438 spent on new equipment.

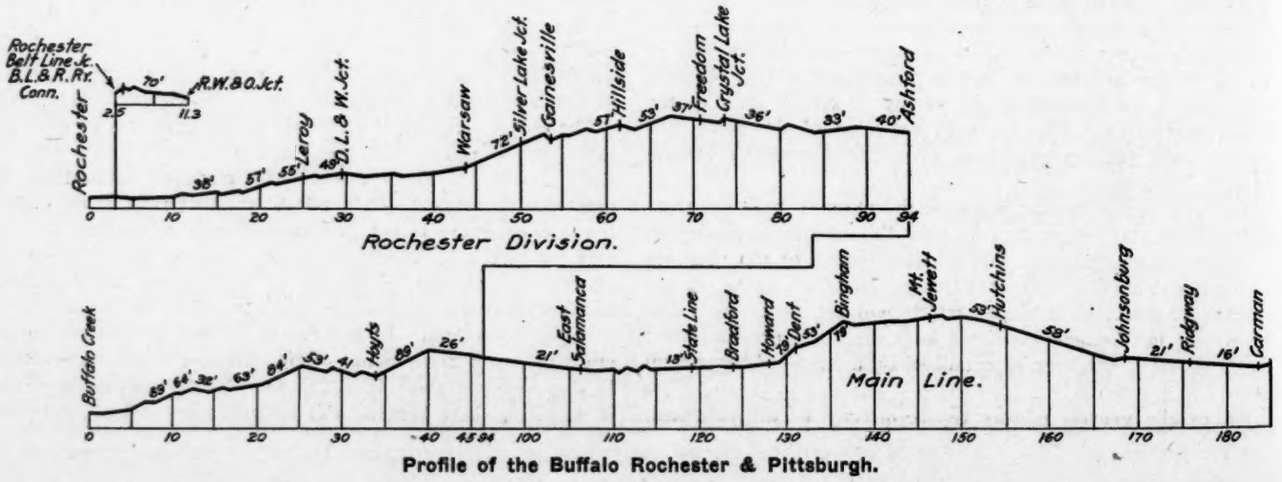
It is interesting to note that by far the larger proportion of the sums spent for additions and betterments, other than equipment and double tracking, was spent to avoid waste of material and labor, such, for instance, as water storage reservoirs, mechanical coal and ash handling facilities, and creosoting plant where ties, piles, bridge timber and other structural lumber is creosoted.

In 1909 the company's locomotives had an average tractive effort of 30,995 lbs., in 1912 this had been increased to an average tractive effort of 33,180 lbs. Freight service cars had an average capacity in 1909 of 36.62 tons, and in 1912 an average capacity of 40.23 tons, with less than 1 per cent. out of a total of more than 16,000 cars out of service for repairs, and 90.69 per cent. of locomotives out of a total of 300 in service in good condition.

The provisions for water supply are very important as an added asset of the company, but, for the purpose of our study, are only one of the many details that go to explain the results that the operating department has obtained, and their importance is more a question of farsighted investment for the future than immediate moment to the operating department, although the latter advantage should not be overlooked.

The total ton mileage moved behind the drawbar, including passengers and freight and weight of equipment in 1909, was 2,202,189,301. In 1912 this ton mileage was 2,994,457,899. Car loading per loaded car was 12 per cent. greater in 1912 than in 1908.

Trainload is often taken as a measure of the efficiency of *operation* as between different railroads. As a matter of fact trainload is often more nearly a criterion of traffic conditions than of operating conditions. Take an extreme example; a road having freight mainly made up of merchandise and bulky commodities, such as dry-goods and furniture, may show a trainload of 300 tons, while a road with a large proportion of its tonnage furnished by products of mines and heavy manufactures, such as originate in the Pittsburgh district, may show an average trainload of 600 tons, and yet the road with the low grade tonnage may not actually be operated with as great economy as the road with the high grade tonnage. Even as an indication of greater



Profile of the Buffalo Rochester & Pittsburgh.

or less efficiency from year to year, on the same road the trainload is not a sure guide to conditions of operation. Too much emphasis cannot be laid on this consideration because it is seldom given due weight in discussions of operating efficiency.

Total empty car mileage is largely a matter that is a concern of the traffic department rather than of the operating department. A gain of 50 per cent. in operating efficiency on a road like the B. R. & P. would reduce empty car mileage to an almost negligible degree. It is true that with heavier power, elimination of grades, etc., the average trainload can be increased, but these things are only two of numerous handles by which the management of a railroad grasps the problem of reducing operating costs and of increasing operating efficiency. The B. R. & P. has in use tonnage rating machines at important terminal yards that have helped materially in giving engines their full rating. Operation is a continual game in which new conditions have to be met, and in the last analysis the best measure of whether or not the operating department is working to the best advantage lies in the answer to the question: Is the shipper receiving the service which will induce him to use this particular road, rather than another, at a cost that leaves the railroad a gainer from his traffic and not a loser?

This means in the first place that the road must have sufficient equipment to handle the business which it can under the most favorable operating conditions originate. This equipment must be utilized to its fullest possible capacity under the conditions that occur from month to month. Train despatching, car loading, motive power, organization, all play their part, and organization is not the least important of these factors.

The conclusion from all this is that it is not so much increased facilities that have enabled the B. R. & P. to obtain the results that have been obtained as increased efficiency in the use of these facilities. Now comes a question as to what has been the trend of costs of performing this additional service. We know that the scale of wages paid employees has materially increased during the four years 1909 to 1912. Has the cost of doing business on the B. R. & P. increased in anything like the proportion that the business done has increased? In other words, making full allowance for the increased scale of wages, has the management been able to show anywhere near the same increases in efficiency as has been shown in the use of the physical plant? The B. R. & P., like every other road in the country, has shown materially larger labor costs.

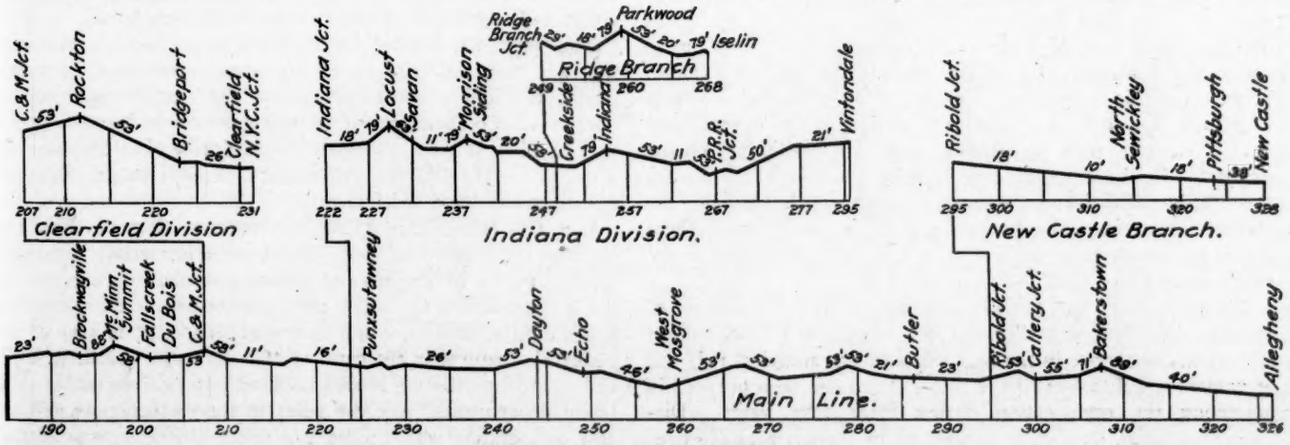
Reducing this cost to a gross ton mileage* basis, transportation expenses in 1909 per gross ton passenger mile cost 0.2837 cents and in freight service transportation cost 0.0810 cents per gross ton mile. In 1912 the cost in passenger service for transportation expenses was 0.3135 cents and in freight service, 0.0906 cents. This is an increase in cost of moving passenger business of 10.5 per cent. and in cost of moving freight business of 11.9 per cent. During these four years the scale of wages on the Buffalo, Rochester & Pittsburgh for all classes of employees in train service has increased approximately 12 per cent.

While transportation expenses can be so accurately divided as between passenger and freight, it is not possible to divide maintenance of way expenses except on some arbitrary basis. Maintenance of way, however, can be fairly accurately divided. The question of dividing these expenses as between passenger and freight is not one which can be solved in any general way. Each road is a different problem. On the Buffalo, Rochester & Pittsburgh there is no very fast passenger service. It is strictly accurate to say that the roadbed, bridges, etc., would be kept in just as high a state of repair and the standard of upkeep would be the same whether or not there were any passenger trains running. Rails, ties and ballast wear out on such a road in proportion to the tonnage hauled over them where there is no complicating factor of high speed. If we divide, therefore, all the maintenance of way expenses on a ton mileage basis, with the exception of those expenses such as freight and passenger station maintenance, which can be divided directly, we would get for the B. R. & P. a fairly accurate apportionment of these expenses as between the two classes of service. Maintenance of equipment can largely be charged directly either to freight or passenger equipment, according to the object of the expenditure, and it is fair to divide the other expenses under the head of maintenance of equipment on the same ratio as between freight and passenger as are the expenses under this head that can be charged direct.

General expenses must be divided on some arbitrary basis. On a road like the B. R. & P. a ton mileage basis seems a fairer basis than a train mileage basis. Using this method, namely, to divide transportation expenses on the basis on which they are actually made and the remainder on a train mile basis; to divide maintenance of way expenses on a ton mileage basis, with certain exceptions; maintenance of equipment on the basis of actual expenditure or on this proportion; and general expenses on a ton mileage basis, we find that the cost per gross ton mile for all expenses for freight in 1909 was 0.194 cents and in 1912, 0.199 cents. For passenger business the cost was 0.445 cents in 1909 and 0.464 cents in 1912. Since the receipts for freight are on a net ton mileage basis and for passengers on a passenger mile basis, it is interesting to divide costs on this same basis. The cost per revenue ton mile in 1909 was 0.320 cents and in 1912, 0.328 cents. The receipts per revenue ton mile, including receipts for switching service, were 0.488 cents in 1909 and 0.486 cents in 1912. The cost per passenger mile in 1909 was 1.526 cents and in 1912, 1.534 cents, while the receipts per passenger mile in 1909 were 2.225 cents and in 1912, 2.387 cents. The company figures its expenses on a train mile basis and shows a loss on passenger business and a profit on freight business; but, as was previously suggested, on the basis on which expenses are divided here, there is a profit shown on both freight business and on passenger business.

The gross ton mile is a better basis on which to estimate costs

*By "gross ton miles" throughout is meant total of lading and equipment, passenger weights being estimated.



Profile of B. R. & P. (Continued).

of repairs of locomotives than any other that the writer knows of, when the object to be attained is the comparison of cost as between different years on the same road. Of course, where one road is to be compared with another the effect of grades is so great that this unit of comparison loses much of its meaning; but over a period of four years on the same road where the grades have not been materially changed, the cost of repairs of locomotives per gross ton mile is an accurate measure of the efficiency of the motive power department. Increases in labor cost have affected the cost of repairs of locomotives so that if we were to find no higher cost in 1912 than in 1909 it would be fair to assume that there has been an increased efficiency in this department. As a matter of fact, however, the repairs of passenger locomotives cost 0.0466 cents per gross ton mile in 1909 and 0.0457 cents in 1912, and the repairs of freight locomotives per gross ton mile cost 0.0181 cents in 1909 and 0.0138 cents in 1912. This is a remarkably good showing.

It should be borne in mind that this study of cost was for the years 1909 to 1912, inclusive. The Mikado locomotives, which have been put into freight service, and the Pacific type locomotives, which have been put into passenger service, were not in use in the fiscal year 1912, so that the effect of their use cannot be shown in this discussion. This is true of other improvements which the B. R. & P. has made or is making in the present fiscal year. Telephone train despatching, which has been in use on the Rochester division for some time, is being extended to the Middle and Pittsburgh divisions. Automatic block signals are being installed this year on the Rochester division, but none of these things had an effect on the cost or in the quality of service in the four years 1909 to 1912.

The B. R. & P. has recently put into effect a new system of applying discipline, and while this new system, of course, did not affect costs of service in the four years we are studying, it is one of numerous indications of the policy which has been pursued in perfecting the organization during these four years. Discipline on the B. R. & P. is decided on by a court presided over in the case of trainmen either by the trainmaster or the superintendent. Heretofore a man was disciplined by being suspended for a certain number of days. Under the new system, discipline is decided on in the same manner as before, but its application is withheld unless there should be cause for further discipline within a specified period of probation. A man who has committed some fault which the court decides should be visited with a suspension is put on probation for six months, a decree of suspension of over ten days and less than 30 days makes the period of probation nine months, and a decree of suspension of 30 days or over calls for a period of probation of one year. If an employee keeps a clear record during this period of probation, at the end of that time his slate is wiped clean and he starts over again. Should, however, the employee get into trouble during his period of probation, he must at once serve the suspended sentence which the court found him liable for, and in addition a new period of probation is started. This system has been in effect since October 1 and is working satisfactorily. It is saving money both

BUFFALO, ROCHESTER & PITTSBURGH RAILWAY CO.

SITUATION REPORT 6 A. M. ____ 191_
6 P. M. ____ 191_

NORTH BOUND — LOCATION		ENGINES	FORWARDED SINCE LAST REPORT				READY TO GO FORWARD				Coal for Charlotte Docks		For Genesee Docks		Coal for Dyers Street	Held for Orders and Unassigned	
			Trains	Eb. Miles	Loaded Cars	Empty Cars	Coal	Coke	Other Freight	Empty Cars	Hard	Soft	Coal	Other Freight	Soft	Coal	Coke
PITTSBURGH DIVISION		A	B	C	D	F	G	H	I	J	K	M	N	O	Q	R	S
Allegheny and Willow Grove	AB																
New Castle Jct.	AC																
Butler Jct.	AD																
Echo via DuBois	AF																
" " Clearfield	AG																
On R. V. R. R. for delivery	AH																
Dayton	AI																
Punxsutawney via DuBois	AJ																
Engines at NX for Light Repairs	BH																
TOTALS	BI																
Trains, Engines & Cars Enroute	BJ																
MIDDLE DIVISION		A	B	C	D	F	G	H	I	J	K	M	N	O	Q	R	S
DuBois	BK																
Falls Creek	BM																
On R. & F. C. for Delivery	BN																
Lanes Mills	BO																
Engines at DU for Light Repairs	BS																
TOTALS	BU																
Trains, Engines & Cars Enroute	BW																
BUFFALO DIVISION		A	B	C	D	F	G	H	I	J	K	M	N	O	Q	R	S
East Salamanca via Bfo. Div.	BX																
" " " Roch. "	BY																
Other Points	CA																
Buffalo Creek	CB																

SOUTH BOUND — LOCATION		ENGINES	FORWARDED SINCE LAST REPORT				TO GO FORWARD			
			Trains	Eb. Miles	Loaded Cars	Empty Cars	Empty Cars			Loaded
							Coal	Box	Other Kinds	
PITTSBURGH DIVISION		U	V	W	X	Y	Z	NA	NB	NC	ND
DuBois	DI										
Clearfield	DI										
C. & M. Jct.	DK										
Cummings	DM										
Lucerne	DN										
Iselin	DO										
Iselin No. 3	DP										
Punxsutawney	DQ										
	FO										
TOTALS	FP										
Trains, Engines & Cars Enroute	FQ										
MIDDLE DIVISION		U	V	W	X	Y	Z	NA	NB	NC	ND
East Salamanca	FR										
Bradford	FS										
Clarion Jct.	FU										
Other Points	FW										
	GB										
TOTALS	GC										
Trains, Engines & Cars Enroute	GD										
BUFFALO DIVISION		U	V	W	X	Y	Z	NA	NB	NC	ND
Buffalo Creek	GF										
Ashford	GH										
Other Points	GI										
Engines at BC for Light Repairs	GJ										

Form of Situation Report.

The spirit that lies behind this form of discipline is the spirit that has been the key-note of the management of the property during the four years under review. This is the spirit of co-operation. Co-operation to be successful must assume on the part of all those who participate in it a degree of intelligence and a desire for fair play that will make it possible to eliminate to a certain extent hard and fast rules.

It is this spirit of co-operation that more than anything else explains the results that have been obtained in the last four years. It explains the effectiveness of the methods that are used to run the service and in so doing meet competition. It explains the elimination of red tape and correspondence that is one of the noticeable features in the conduct of business on the B. R. & P., and it explains the remarkable lack of friction between the different departments. We can point to specific instances and tell how co-operation was secured, but under different circumstances to the company and to the employees and is saving a very considerable hardship on the part of the employee's family.

the method of securing this co-operation would be different, although the final result might be the same. The nearest that one can come to a definition is to say that the treatment of officers and men alike is based on the assumption that they will recognize fair treatment, and that they are at heart working for the best interests of the service as a whole.

One of the best ways to eliminate misunderstanding is to avoid unnecessary correspondence. This fact is recognized on nearly every railroad in the country. It is one of the underlying principles of the Hine system of unit organization. It is on the Buffalo, Rochester & Pittsburgh an accomplished fact, and it is an accomplished fact because each department is made an intelligent part of a complete organization. Not only are a few heads of departments permitted to come together in discussion of common problems, but all the officers of each department are made to understand that the great majority of their problems are problems common to other departments. This co-operation is not attained in a mechanical way and therefore does not lend itself easily to description or analysis. The fact that discipline is administered by a joint court, composed of officers from different departments; the fact that there are frequent and informal meetings between officers of different departments for discussion, or that every three months an inspection trip is made of the entire road, in which the heads of all the departments join and during which there is absolutely free discussion, does not do more than tell part of the story. All of these things are aids to the development of this spirit of intelligent co-operation. All of them together would be comparatively weak aids were they not backed up by faith founded on experience. This faith is more effectually engendered by the fact that to the common knowledge of employees and officers, an employee who has met with misfortune through no fault of his own is treated by the company not as a tool which is no longer useful, but in a spirit of real generosity, better than by any elaborate merit system that has yet been devised.

There are certain conclusions that may be drawn from this study of operation on the Buffalo, Rochester & Pittsburgh. Passenger business, even on a road handling a heavy density of freight traffic, can be made a profitable branch of operation. Despite increased costs of operation, competitive business can be profitably developed if enough attention is paid to the development of the service. A loyal and efficient organization can be built up despite competition in the labor market and despite the modern tendency to regard the interests of labor and employer as antagonistic, without endangering the financial results which the management owes to the stockholders of a railroad.

TICKET ISSUING MACHINES ON THE LONG ISLAND.

The Long Island Railroad has in use in Brooklyn, N. Y., a number of machines for simultaneously printing and issuing tickets, and recording the number and value of the tickets issued, and they are working in a very satisfactory manner. The machines look somewhat like the familiar cash registers, seen in retail stores, and were made by the National Cash Register Company, Dayton, Ohio.

Machinery is provided in the metallic case for printing tickets of denominations from 5 cents to 35 cents, inclusive; they are for use only on the local electric trains. The printing mechanism is synchronized with the recording mechanism which shows the number and value of all tickets issued. Four different men can sell from the same machine, the tickets themselves and the automatic recording apparatus indicating by a designating letter the identity of the person making each sale. Each seller may lock the machine so that none of the others can disturb his tickets or his records. A mechanical counter shows the opening and the closing numbers of the tickets issued each day. The counting apparatus also shows the total sales for any given period; and the agent has no reports to make, except a brief statement of the totals. The machines are operated by an electric motor and are capable of printing 100 tickets a minute.

ARBITRATION OF THE FIREMEN'S WAGE CONTROVERSY.

The entire first week of the arbitration proceedings in the Eastern firemen's wage demands was devoted to taking the testimony on the firemen's side and in cross-examination by Elisha Lee, representing the railroads. On Thursday, March 13, W. S. Carter, president of the firemen's brotherhood, called to the witness stand A. H. Hawley, secretary of the organization. Mr. Hawley, whose testimony followed that reported in the *Railway Age Gazette,* March 14, page 479, gave statistics of firemen killed and injured and figures pertaining to the insurance features of the brotherhood. He said that the membership had grown from 48,500 in 1903 to 85,300 at the end of the last fiscal year; that in 1911 and 1912 about 20,000 members had resigned or been dropped and 250 had died. Of the 20,000, less than 5,000, he claimed, joined the Brotherhood of Locomotive Engineers, the others entering other employment. From 1904 to 1912 there were 4,437 deaths, of which 2,124 were from railroad accidents.

Dr. Walter B. Cory, general medical examiner of the brotherhood, the next witness, gave it as his opinion that a fireman's work is extra hazardous and that exposure, heat, and other things weaken the men so that they are more subject to disease. He gave insurance companies' regulations to show that firemen are not considered good risks.

James Kirby, president of a carpenters' union, gave testimony regarding the wages paid in the building trades as compared with those paid firemen. Mr. Carter asked him if it was contrary to rules for a building-trades man to take a drink, either on or off duty, and Mr. Kirby replied that it was not. Mr. Lee interrupted to ask Mr. Carter if he was in favor of a fireman taking a drink while on duty, and the latter replied that he was not. In cross-examining, Mr. Lee brought out that carpenters and other artisans lost considerable time, due to bad weather, and that they furnished their own tools. Mr. Kirby had stated that no examination as to sight, hearing, etc., is required of a building trades man, and Mr. Lee asked him if he thought a color-blind painter would be much of a success. Mr. Kirby thought not.

S. T. Steinberger, of the brotherhood's general offices, gave statistics regarding the number of times firemen had worked over 16 hours, as shown in reports made by the railroads under the law, to the Interstate Commerce Commission. Mr. Carter was careful to bring out that he considered these as unavoidable and not infringements of the law. In cross-examining, Mr. Lee showed that, although a fireman gets paid overtime for time worked in excess of ten hours, the railroads get no increase in ton-miles.

D. B. Robertson, Youngstown, Ohio, a locomotive engineer on the Erie, followed with statistics purporting to show that a fireman's wages will buy much less of the necessaries of life now than in 1907.

Mr. Lee informed the board on Thursday that he had a communication from the Toledo, St. Louis & Western, asking to be permitted to withdraw from the proceedings. Judge Chambers, chairman of the board of arbitrators, refused permission, and when, on Friday, the matter was again brought up Judge Chambers said that the board had power to punish for contempt by certifying to the circuit court for the district, and he believed the Toledo, St. Louis & Western would be in contempt in withdrawing from the arbitration without the board's consent.

W. J. Lauck, a statistician of Washington, D. C., was the next witness. He had prepared tables, which, Mr. Carter stated, had cost the brotherhood $18,000. They dealt with the capitalization, train loads, revenue, etc., of the roads concerned in the arbitration and tended to show that the stockholders were receiving much more benefit from the increases in revenue than the firemen. Tables and statements were given for individual roads and a number of these were dealt with in considerable detail. In dealing with the Baltimore & Ohio, Judge Chambers

calculated that wages had been increased about 48 per cent. in 11 years. Mr. Carter said this was misleading, as Mr. Lauck had been compelled to accept the figures filed by the railroads with the Interstate Commerce Commission, and that these were "absolutely erroneous." Mr. Lee immediately objected to Mr. Lauck's giving any further testimony if the figures were based on erroneous information. Mr. Carter then objected to any testimony along the same lines being introduced by the railroads. He claimed that members of the Interstate Commerce Commission had informed him that the railroads falsified their reports as to employees, and said that if they would falsify under oath to the Interstate Commerce Commission they would falsify to the arbitration board. He claimed that the enginemen got themselves into trouble in their arbitration by using the railroads' reports. Mr. Lee said he did not admit that the figures were false, but as Mr. Carter contended they were, he must persist in objecting to the admission of the tables based on them. Judge Chambers ruled that such a condition did not entirely invalidate the testimony. In the case of the New York, New Haven & Hartford, Judge Chambers asked why, in the face of the figures given, it should be necessary to reduce the dividend rate, which, according to press reports, Mr. Mellen, president of the New Haven, says will have to be done. Mr. Lauck replied that if the financial management had been as efficient as the transportation management, there would be no such necessity.

In cross-examining Mr. Lauck, Mr. Lee made it plain that he disagreed with a great many of his conclusions. One of Mr. Lauck's tables, using as a basis the revenue train mile, showed that operating revenue on the roads concerned had increased from $1.90 to $2.46, while the cost of firemen has increased only from 3.89 cents to 5.64 cents. Mr. Lee, calculating percentages, showed that this meant an increase in revenue of 29 per cent., while the cost of firemen had increased 45 per cent. Judge Chambers asked whether, if some roads could afford to pay more than others, the firemen would ask an increase only on those roads that could afford to pay it. Mr. Carter said if they were doing the work they certainly would ask an increase; and he compared the case with that of two buildings being erected, one by a wealthy contracting firm, and the other by a firm that had difficulties in making ends meet. He contended the workmen should get the same wages on both buildings; but Mr. Lee disagreed, saying that it is a question of demand and supply; that one family would pay a servant seven dollars a week while another paid $10; they paid according to their means.

Mr. Carter was very much afraid that by some of his replies Mr. Lauck was giving the impression that he repudiated some of his previous statements, but Mr. Lauck said he did not; that whatever objections he admitted as being fair, his general conclusions, that the firemen were doing more work, were correct. He admitted to Mr. Atterbury that he was not a practical railroad men and was competent only to pass on the question from the standpoint of an accountant. Mr. Lee again brought in the fact that in comparing the amount of coal handled, etc., for 1902 and 1912, Mr. Lauck had used percentages, and contended that the same method should have been used in other comparisons. Mr. Lauck said that revenue had increased 40 times as much as the cost of firemen, but Mr. Lee stated that increased operating expenses had absorbed a very large percentage of the increase. Mr. Lauck thought the firemen should be paid the same on two similar competing roads, even if one had a surplus and the other a deficit. Mr. Carter here brought in the question of weight on drivers, saying that payment on that basis meant payment according to productive capacity. He made a comparison between firemen and steel rail manufacturers, saying that if the railroads are prosperous the rail makers make a profit, and that when the mills cannot make a profit they stop making rails. Mr. Lee replied that, unfortunately, when the railroads do not make a profit they have to go on operating just the same. Mr. Carter again brought up the question of falsified reports made to the Interstate Commerce Commission, and repeated his previous statement regarding them. Mr. Lee replied that they were not false and that they were made according to the commission's requirements. He read from a statement of the commission in the railroad rate case, which said that railroad labor was paid as well as, and sometimes better than other forms; and that an increase in rates could not be permitted for the purpose of paying extravagant wages.

REPORT ON COLLISION AT BOWERSTON, OHIO.

The Interstate Commerce Commission has issued a report by Chief Inspector H. W. Belnap, on a rear collision of freight trains, causing the death of one employee, which occurred on the Pittsburgh, Cincinnati, Chicago & St. Louis, near Bowerston, Ohio, December 13, last. The line at this point is worked by the manual block system. A west bound freight, Extra, No. 8020, unexpectedly stopped when its rear car was about 1,500 ft. west of O B tower, and 1,000 ft. west of the home signal connected with this tower, was run into by a following freight, Extra, No. 8188. The collision occurred at 5:12 p. m., and the second train had been running at about 51 miles an hour from the last preceding station. Engineman Stocker, of this train, was killed. The flagman of the standing train had gone back and placed a red fusee on the track immediately in front of the tower, 1,500 ft. in the rear of his train. He was called in and had got back to his train a few minutes before the collision.

Freight trains are run under permissive block signals, and after the passage of train 8060 the signalman at O B had set his home signal at 45 degrees, indicating that the block section was occupied. With the signal thus set, he was able to give a clear distant signal, and this he did; this being the usual custom. As train 8060 had passed out of sight, the signalman acted in accordance with the prescribed methods, in displaying a clear distant signal to No. 8188. This, says the inspector, is not adequate protection. Moreover, the spectacles on the distant signal are so arranged that when the signal arm stands at 45 degrees, as it might if the connections were out of adjustment, a passing train would find no light at the distant signal, and might easily miss it; and thus would approach the home signal at an unsafe speed. Although the freight was running at about 50 miles an hour, there is a rule limiting the speed on this part of the road to 40 miles an hour. This rule had been in effect only 19 days. The inspector finds that it has been habitually disregarded, the train sheets showing many violations between November 24 and December 31.

Though the signalman did not disobey any rule, he is criticized for using bad judgment, especially when there was a red fusee burning directly in front of his cabin. The traffic on this division, says the inspector, is heavy enough to justify the use of block signals its entire length. A number of short sections are already thus equipped. Concerning the excessive speed of the freight train, the inspector says: "That the enginemen on this division pay no attention to the established speed restriction is a matter of daily record, and their failure to observe the rule must have been known and acquiesced in by the operating officers. Such dereliction of duty by those who are charged with the enforcement of regulations cannot fail to weaken respect for all rules and render nugatory all efforts to maintain really effective discipline. Rules that are not intended to be enforced have no proper place in a railroad company's code of regulations, and when the operating officers of a railroad permit rules that have been enacted to secure safety to be violated with impunity, they cannot reasonably expect to escape responsibility for the consequences of such violation." The inspector calls for a flagging rule entirely free from uncertainty or indefiniteness; one which would leave no room for error of judgment by a flagman.

POSTAL CAR ILLUMINATION TESTS.

Results of Extensive Tests Made by the Baltimore & Ohio, and Used as a Basis of the New Government Specifications.

The character of the visual work performed in the railway postal car requires a high quality of illumination, and the long hours during which artificial light is required, make the problem of furnishing a reliable and economical supply a difficult one. For the purpose of obtaining more adequate data on this subject the Baltimore & Ohio, through its electrical department, made an extensive series of tests during the fall of 1912 in Washington, D. C., on one of its latest types of steel postal cars. The standardization of the construction and of the arrangement of this type of car makes it possible to draw conclusions from these tests that will generally apply to cars built under the present government specifications.

Although the tests were carried out on a broad engineering basis, covering all practicable methods of car illumination available at the present time, the investigation was confined solely to the question of providing proper and adequate illumination. The questions of maintenance, of the most desirable kind of illuminants, and of the operating problems connected with the generation of light were not considered further than with respect to their influence upon the quality of illumination provided. In detail, the phases of the subject covered were the relative suitability of: first; Pintsch gas and electricity, representing the most important types of primary illuminants, as far as their influence upon the quality of illumination produced was concerned; second, the different types of reflectors and diffusers; and third, the different types and arrangements of lighting units. The investigation consisted of illumination tests to ascertain efficiency and uniformity data as well as shadow effects obtained with the various types of lighting units and spacing arrangements; also, visual intensity tests to ascertain the intensities of illumination required in the different sections of the car by the character of the visual work performed in those sections.

Two important features brought out by the investigation were; that adequate illumination may be provided with the amount of light that is at present generally provided by most railroads, the unsatisfactory illumination frequently obtained being largely due to the improper arrangement of the light units and unsatisfactory types of reflectors; and that the amount of illumination required for the work in the postal service has been considerably over-estimated.

In the direct system of illumination the correct location of the light is determined by absence of the shadows. In the bag rack section of the car the light units should be located along the center line of the car and the mounting height should be 7 ft. 7 in. from the floor to the center of the lamp filament or gas mantle in order to produce the least objectionable shadow effects as well as to eliminate shadows on the rear bag rack label. At the letter cases adequate illumination can be provided for only by light units independent of those used for illumination of the body of the car, and such light units should be located as far in front of the case as possible without shadows being thrown on the work by the body of the mail distributor. With the standard design of letter case having a 17 in. table this distance is 20 in. from the front of the letter case.

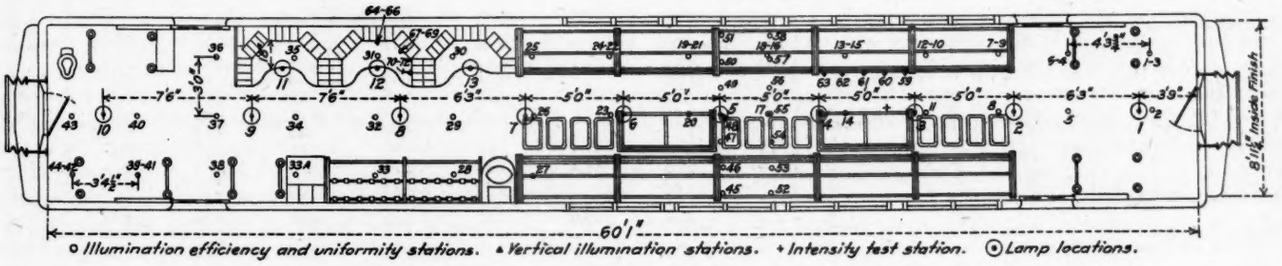


Fig. 1—Location of Stations and Lamps with 5-ft. Spacing.

In determining the best types of reflectors for postal car service four qualities were considered; the effect of the resultant illumination upon the eye; the relative efficiency; the cleaning consideration; and the liability to breakage. As these are not of equal importance the following relative values of these qualities were chosen after considering the question from several different points of view. Out of a total of 100 points an importance represented by the following figures was assigned to each of the qualities under consideration:

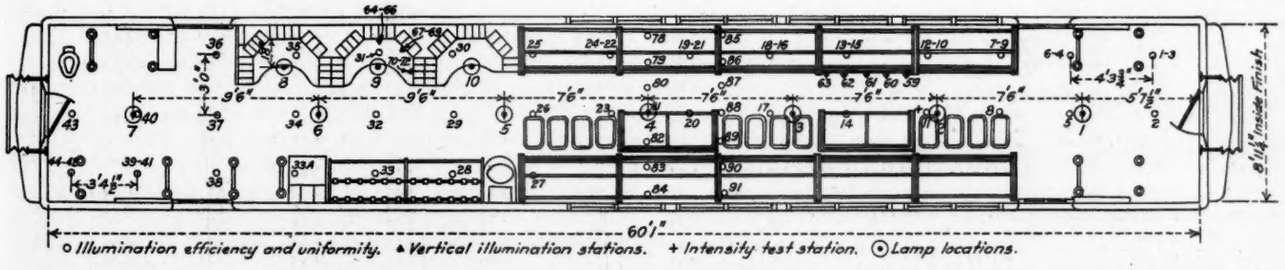


Fig. 2—Location of Stations and Lamps with 7½-ft. Spacing.

Effect on the eye	44
Efficiency	30
Cleaning	18
Breakage	8
Total	100

On this basis the relative suitability of the various types of reflectors for postal car lighting was found to be as follows:

Class of Reflector.	Make of Reflector Represented in Tests.
Aluminumized metal	Holophane D'Olier No. 18460 body of car; Holophane D'Olier No. 18470 at letter case.
Heavy density opal glazed reflecting surface (specially designed for car lighting service)	Holophane No. 18626 redesigned.
Medium density opal glazed reflecting surface	Phoenix CL-50.
Porcelain enameled metal	Holophane D'Olier No. 18461.

Class of Reflector.	Make of Reflector Represented in Tests.
Medium density opal depolished reflecting surface	Macbeth-Evans Alada No. SF-1623.
Indirect lighting with enameled reflectors for gas lighting	Experimental enameled reflector.
Mirrored glass (direct lighting)	X-Ray 555.
Prismatic clear	Holophane No. 18226.
Prismatic satin finish	Holophane No. 18226-SF.
Reflecting and diffusing globes	Safety Corona No. 8026.

Extensive tests to determine the amount of illumination required for comfortable reading indicated that there was an appreciable difference in the character of the illumination afforded by different types of equipment. Certain types gave an illumination of such a character as to leave the eye in a less satisfactory condition for vision, thus requiring an increased intensity of illumination for adequate vision. For practical purposes it was found that with direct lighting systems the equipment could be divided into two classes relative to the character of illumination produced; one in which the specular element was considerable, such as was obtained from direct lighting systems employing mirrored glass, porcelain enameled, heavy density opal reflectors with glazed reflecting surface; and one in which the illumination was largely diffused, such as was obtained from direct lighting systems using diffusing globes, opal reflectors of all classes ex-

A SUMMARY OF THE BALTIMORE & OHIO ILLUMINATION TESTS.

Installation.	Entire Car.			Bag Rack Section.			Letter Case Section.		Storage Section.
	Nature of Value.	Foot candles.	Per Cent. Useful Lumens.	Ft. C. Center of car.	Ft. C. Mouth Bags.	Ft. C. Vertical on Pap. Bx.	Horizontal Ft. C.	Vertical Ft. C.	Foot candles.
Mirrored glass, X-Ray 696, 5 ft. spacing, 1 3/16 in. position	Avg.	6.03	62.3	12.04	3.77	3.74	10.75	4.67	3.84
	Max.	17.90	....	17.90	3.98	4.74	13.70	7.04	8.90
	Min.	2.12	....	7.28	3.37	2.16	8.80	2.72	2.12
Prismatic clear, Holophane 18226, 5 ft. spacing, 1⅜ in. position	Avg.	5.28	54.6	8.38	3.45	1.95	7.87	4.48	3.65
	Max.	14.65	....	9.36	3.69	2.46	9.52	6.67	6.76
	Min.	2.02	....	7.72	3.20	1.59	6.42	2.01	2.02
Prismatic clear, Holophane 18226, 7½ ft. spacing, 1⅜ in. position	Avg.	3.97	53.4	6.13	2.47	1.17	6.94	4.48	2.92
	Max.	11.30	....	8.39	3.40	1.60	7.67	6.67	8.00
	Min.	.89	....	4.79	1.97	.97	6.14	2.01	.89
Heavy density opal, Holophane 18626, 5 ft. spacing, 1⅜ in. position	Avg.	5.00	51.8	8.33	3.59	2.75	7.69	5.05	3.42
	Max.	11.55	....	10.38	3.93	4.06	9.03	8.54	6.46
	Min.	2.09	....	7.66	3.26	1.91	6.17	2.27	2.09
Heavy density opal, Holophane 18626, 7½ ft. spacing, 1⅜ in. position	Avg.	4.20	56.4	5.87	2.76	1.74	7.83	....	3.04
	Max.	12.52	....	9.49	3.76	3.35	9.79	....	8.83
	Min.	1.03	....	4.63	2.38	.98	6.51	....	1.03
Medium density opal, Phoenix 10456, 5 ft. spacing, 1⅜ in. position	Avg.	4.14	42.8	6.31	3.43	4.01	5.36	3.01	2.96
	Max.	8.45	....	7.62	3.72	4.65	5.72	5.09	5.50
	Min.	2.14	....	5.71	2.91	3.19	4.78	1.22	2.14
Prismatic satin finish, Holophane 18226 SF, 5 ft. spacing, 1⅜ in. position	Avg.	3.78	39.0	6.07	2.89	2.52	5.51	3.16	2.74
	Max.	7.95	....	6.87	3.13	3.08	6.14	5.10	4.73
	Min.	2.09	....	5.36	2.51	1.99	4.95	1.46	2.09
Aluminumized metal, Holophane D'Olier 18460 and 18470, 5 ft. spacing, 1⅜ in position	Avg.	4.28	44.2	5.86	3.35	2.66	8.42	3.95	3.03
	Max.	9.51	....	6.14	3.57	3.69	9.51	5.86	5.19
	Min.	2.39	....	5.58	2.96	1.35	7.13	2.23	2.39
Aluminumized metal, Holophane D'Olier 18460 and 18470, 7½ ft. spacing, 1⅜ in. position	Avg.	3.38	45.3	4.37	2.50	1.46	7.64	3.95	2.43
	Max.	8.84	....	5.21	2.83	3.38	8.84	5.86	4.50
	Min.	1.15	....	4.02	2.23	.58	6.87	2.23	1.15
Medium density opal, Macbeth-Evans SF-1623, 5 ft. spacing, ⅝ in. position	Avg.	3.98	41.1	5.84	3.39	3.34	5.19	3.31	2.96
	Max.	7.85	....	6.65	3.68	4.20	5.54	5.90	4.90
	Min.	2.38	....	5.43	2.86	2.51	4.71	1.45	2.38
Medium density opal, Macbeth-Evans SF-1623, 7½ ft. spacing, ⅝ in. position	Avg.	3.10	43.0	4.26	2.45	1.89	4.46	3.31	2.36
	Max.	6.76	....	6.02	3.12	3.18	4.83	5.90	4.46
	Min.	1.32	....	3.65	2.25	1.25	4.04	1.45	1.32
Enameled metal, Holophane D'Olier 18461, 5 ft. spacing, 1⅜ in. position	Avg.	3.86	39.9	5.78	3.12	2.85	5.62	4.09	2.74
	Max.	8.17	....	6.80	3.26	4.04	6.21	7.17	5.32
	Min.	1.67	....	5.48	2.76	1.75	4.77	1.56	1.67
Enameled metal, Holophane D'Olier 18461, 7½ in. spacing, 1⅜ in. position	Avg.	3.23	43.4	4.39	2.38	1.47	5.44	4.09	2.52
	Max.	7.94	....	6.70	3.00	2.97	6.31	7.17	5.42
	Min.	1.26	....	3.68	2.08	.80	4.67	1.56	1.26
Heavy density opal, Opalux 123, 5 ft. spacing, 1 3/16 in. position	Avg.	3.73	38.5	5.51	3.14	4.27	4.98	3.63	2.84
	Max.	7.00	....	6.15	3.36	5.52	5.26	6.60	5.33
	Min.	2.11	....	5.07	2.58	2.83	4.65	1.34	2.11
Medium density opal, Phoenix CL-50, 5 ft. spacing, 1⅜ in. position	Avg.	3.81	39.4	5.54	3.12	2.63	5.11	3.46	2.87
	Max.	7.92	....	6.30	3.28	3.14	5.68	.58	5.11
	Min.	1.75	....	5.13	2.57	2.13	4.45	1.46	1.75
Reflecting and diffusing, Adams & Westlake 15050, 5 ft. spacing	Avg.	3.06	31.6	4.79	2.45	4.14	4.34	....	2.18
	Max.	5.63	....	5.42	2.85	4.51	4.78	....	4.56
	Min.	1.21	....	4.32	2.16	3.63	3.82	....	1.21
Bare lamps, 5 ft. spacing	Avg.	2.71	28.0	3.79	2.46	4.36	2.72	1.94	2.10
	Max.	5.20	....	4.11	2.84	4.59	2.93	3.86	3.69
	Min.	1.65	....	3.42	2.00	4.14	2.56	.59	1.65
Aluminumized metal, Holophane D'Olier 18440, 5 ft. spacing, "O" position, 15 watt lamps	Avg.	2.28	44.6	3.63	2.10	2.34	2.28	1.69	1.62
	Max.	4.15	....	3.96	2.23	3.54	2.71	3.05	2.77
	Min.	.38	....	3.32	1.99	.98	1.50	.57	.58
Mirrored glass (indirect lighting), X-Ray E-100, 50 watt lamps, 10 ft. spacing	Avg.	2.37	26.1	3.34	1.82	1.46	1.90	1.49	2.05
	Max.	4.26	....	3.87	2.24	1.78	2.18	1.99	4.26
	Min.	.84	....	2.89	.84	1.14	1.58	.95	.93
Gas Lighting.									
Aluminumized metal, Holophane D'Olier 18418 and 18490, mantle 3044, 7½ ft. spacing	Avg.	5.95	44.5	7.24	4.07	2.30	15.4	6.08	4.78
	Max.	17.10	....	7.96	4.59	5.16	17.10	8.90	8.33
	Min.	2.47	....	6.51	3.65	.93	12.55	3.69	2.97
Enameled metal, Holophane D'Olier 18417 and 18479, mantle 3044, 7½ ft. spacing	Avg.	4.91	37.2	6.66	3.72	3.78	9.40	6.32	4.24
	Max.	11.88	....	7.37	4.06	8.90	11.88	11.80	7.78
	Min.	2.29	....	5.60	3.13	1.60	7.12	2.59	2.74
Aluminumized metal, Holophane D'Olier 18410 and 18490, mantle 3044 and 2640, 7½ ft. spacing	Avg.	4.88	45.0	5.61	4.01	4.54	11.22	5.15	3.92
	Max.	13.50	....	6.26	4.47	9.18	13.50	7.51	5.48
	Min.	2.78	....	4.52	3.09	2.03	9.63	3.05	2.92
Reflecting and diffusing globe, Safety Corona 3425, mantle 3044, 7½ ft. spacing	Avg.	4.10	30.7	5.47	3.47	5.26	5.20	5.04	3.46
	Max.	7.80	....	6.79	6.00	6.26	5.83	8.85	6.23
	Min.	2.04	....	4.59	2.63	4.60	4.67	1.89	2.04
Reflecting and diffusing globe, Safety Corona 8026, mantle 3044, 7½ ft. spacing	Avg.	3.86	28.9	5.18	2.85	4.56	5.56	4.05	3.37
	Max.	8.23	....	5.95	3.23	6.05	6.22	6.60	6.20
	Min.	2.00	....	4.25	2.42	3.72	4.83	1.93	2.00
Diffusing globe (opal), Safety 3116, mantle 3044, 7½ ft. spacing	Avg.	3.27	24.0	4.58	2.19	3.48	5.59	3.20	2.79
	Max.	6.81	....	5.63	2.63	4.73	5.94	4.94	5.79
	Min.	1.50	....	3.52	1.84	2.80	5.41	1.69	1.50
Enameled metal (indirect lighting), Safety mantle, "125 C. P.," 10 ft. spacing	Avg.	2.06	18.9	3.13	1.70	1.36	1.38	.77	1.95
	Max.	3.35	....	3.34	2.20	1.56	2.02	1.03	3.14
	Min.	.90	....	2.88	1.13	1.19	1.04	.51	.90

cept heavy density opal with a glazed reflecting surface, aluminumized metal, and prismatic reflectors. This class of reflectors required approximately 80 per cent. of the illumination of the first class. Extensive tests made to ascertain the intensities of illumination required, showed that 2.25 foot candles on the reading plane was a safe value for minimum satisfactory intensity for continuous close visual work under illumination derived from lighting units of the second class. On the same basis it was found that 3.5 ft. candles was ample illumination and that higher values were unnecessary for adequate service. It was further found that about one-half or slightly less of this minimum intensity value was required at the mouth of mail bags in the bag rack portion of the car, on the face of the letter cases and in the storage section. The results of the illumination tests with the principal types of electric and gas units tested are given in the accompanying table. Figs. 1 and 2 show the plans of the test car giving the location of the lighting units and of the test stations. The table gives the average, maximum and minimum foot candle values obtained in the car as a whole, the bag rack section, the letter case section and the storage section. The efficiency of the system is given as the ratio of light falling on the working plane to the total light generated by the lamps.

The importance of using proper types of reflectors in car lighting service for all classes of cars is shown in the comparison of the illumination obtained with the most efficient type of reflector tested, the mirrored glass, with the bare lamps, in which the illumination obtained on the working plane where the reflector was used was practically 220 per cent. of that obtained with the bare lamps, the number of lamps installed being the same in each case. The ceiling of the car had been freshly painted a dead white, which gave more favorable conditions for the bare lamps than would generally be obtained in service. Further, the glare effect obtained from the bare lamps is such as to render the eye much less efficient as well as more susceptible to severe eye strain than where reflectors are used.

The minimum and maximum initial illumination values, as well as the service illumination values required under the Post Office Department specifications, revised to December 28, 1912, were determined upon as a result of these tests in this connection, and they constitute the only authentic data thus far available on this subject.

So far as the question of illumination is concerned the investigation showed that when proper location of lamps and proper types of reflectors are provided, equally satisfactory results may be obtained with Pintsch mantle gas lighting and electric lighting. In conducting the tests the assistance of illuminating experts of the leading reflector, car lighting fixture, and incandescent lamp manufacturers was obtained, and in order to insure the greatest accuracy of the test results the National Bureau of Standards extended its co-operation by calibrating the instruments, rating the lamps used, and making photometric curves of all the light units tested.

Acknowledgment is made by the railway company to the Holophane Works of General Electric Company, Safety Car Heating & Lighting Company, Adams & Westlake Company, National Electric Lamp Association, General Electric Company, Westinghouse Lamp Company, Macbeth-Evans Glass Company, National X-Ray Reflector Company, Phoenix Glass Company, Opalux Company, and the National Bureau of Standards for their co-operation in conducting this research.

PROPOSED SPANISH RAILROAD.—The *Gaceta de Madrid* of a recent date contains a notice inviting plans for the construction of a secondary 17-mile railway from Haro to Ezcaray, province of Logrono. The minimum rolling stock of the company will consist of 4 locomotives, 5 mixed first and second class cars, 5 third-class cars, 3 mail cars, 4 baggage cars, 12 box cars, and 23 flat cars. The capital necessary for the construction is calculated at $542,833. The Spanish government will guarantee 5 per cent. per annum on the capital invested.

WHAT I AM TRYING TO DO.*

BY FRANKLIN K. LANE.

What are we of the Interstate Commerce Commission trying to do? We are seven, but we work as one. It would be hard to find seven men who differ more in temperament, in training, or in type of mind than Mr. Clements of Georgia, Mr. Prouty of Vermont, Mr. Clark of Iowa, Mr. Harlan of Illinois, Mr. McChord of Kentucky, Mr. Meyer of Wisconsin, and the writer. Yet I believe that no other group of men labors for the Government with more singleness of purpose than does this commission. There is, of course, a flat-footed way of stating our purpose—one transcribed from the letter of the statute: We are attempting to regulate and control the rates, rules, and practices of our railroads, and of other public utilities engaged in interstate commerce. (Herein, however, I shall deal only with railroads.) I recognize that such a statement is about as luminous as to say that the President of the United States is trying to enforce obedience to the nation's laws and give direction to its policies. Succinctly and suggestively put, it may be said that the object of each day's work—the investigations made, the rulings and orders issued—is to insure fair play as between the public who need transportation service and the carriers who furnish it.

In a very real, though not perhaps a strictly legal, sense we legislate within fixed limitations. The effectiveness of our work has been made possible only by the liberality of the Supreme Court in the construction of this law and of the powers of the commission.

It is entirely within the truth to say that this commission has no policy other than that which is expressed from day to day in the rulings that it makes. At the same time it would be idle to say that we are without consciousness of direction.

Our primary object must be to prove the efficacy of the machinery devised by law for bringing the policy of our railroads into conformity with the policy of the law—to make private capital serve public need and yet conserve the interest of the railroad owner. The public wish the best of service at the lowest possible rates; the owners desire the highest return consonant with the fulfilment of their undertaken duties. This may be an *impassé*—a situation so impossible of resolution that we are destined to join those nations who are experimenting with governmental ownership and operation. The stage of despair, or of resolution—dependent upon the viewpoint—we, however, have not yet reached. In fact, I believe we are far from it, for we have only entered upon the experiment of regulation by commission, and students of this subject from other lands have said that their countries would not have sought refuge in governmental ownership had they in time discovered the American method of dealing with the railroad problem.

In this experiment we are trying above all to be practical; to work with facts. If wise we are not to be terrorized by our own precedents or those of the railroads themselves; less than a century of experience is too short a time within which to say the final word upon any problem of railway economics. And constantly there is this all-important factor to be safeguarded; the self-respecting, self-asserting, risk-taking, personal initiative of the railroad man whose imagination and experience must be sympathetically brought into public service if the whole scheme of regulation is to become more than a flat code of lifeless rules.

In earlier days railroad men accepted uniformly the current law of competition as a full code for the government of their conduct. It was their business as practical men to make their properties as profitable as possible. They did not understand the philosophy which distinguished their properties from other business enterprises. Regarded from this standpoint, their practices became entirely reasonable.

To be sure, railroad policies differed. This was because railroad men differed. Some had larger imaginations than others

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*From an article in the March issue of *World's Work*. This abstract is reprinted by kind permission.

and comprehended more perfectly the import of their conduct. But railroading was to all an industry. Its product was tons of freight hauled or passenger miles made. To cut a rate to secure traffic was thought to be no more offensive to good morals or fair dealing than for one contractor to underbid another in the selling price of a house.

In superimposing restraint upon these carriers—a restraint which the law had always recognized as possible—and in attempting to enforce the regulations now imposed, it is not to be overlooked that our railroads were built in large part upon this private industry theory. As a nation we took no more concern as to where a railroad was to be built or how it was built than we did as to where a man should live or how he lived. It was any one's privilege to build a railroad. Given a financier of underwriting reputation, a road could be projected from Dan to Beersheba without any one knowing the location or the traffic-producing possibilities of either place. The result was as pretty a system of unscientifically planned railroads as might well be imagined, and not only unscientifically planned, but illy and uneconomically built. Originally they were erected to serve local needs. Many of them were later connected into nation-serving carriers by the strength and synthetic genius of a few men. But as a whole they were without large plan, built upon a speculative and competitive basis, and operated as rival industries. Logically, therefore, and perhaps inevitably, they fought their way to the edge of bankruptcy, or beyond. Then, to save themselves, they took refuge in combinations, pools, and agreements under which they raised rates and reduced service.

It would be difficult, I think, to find a self-respecting railroad man who would presume to say to the American people that he would prefer to return to the order of things that prevailed before the government undertook regulation of railroads.

It is said that railroad regulation restricts railroad building. No doubt this is true in part. This commission has no power to permit a railroad to be built or to deny it that right. Nevertheless, the powers that we do exercise doubtless have an influence in limiting the building of certain types of roads, notably those whose primary purpose is not public service but a species of blackmail upon other roads or those whose rails are laid as a foundation for wildcat speculation. Let us be frank, however, and inquire why, the country over, we are not building railroads with that same feverish activity that characterized the '70's and '80's. Manifestly one reason is that there is not the opportunity. The railroad map of the United States in 1861 showed about 35 000 miles of railroad; that of 1910 nearly 250,000 miles. The greater part of this development took place in the two decades following the Civil War. There are now few large spaces on that map which remain unsupplied with the major transportation facilities. Nor have the people so much to give by way of bounty as they had in earlier days when they donated to the railroads of the country a tract of land amounting in the aggregate to seven times the superficial area of the State of Pennsylvania. Naturally this condition could not continue indefinitely. There followed a period of reaction in which many lost all that they had ventured in these properties, and now, out of this welter of building, organizing, and reorganizing, we have come upon a period of greater stability in which we are making fuller use of the utilities we have, placing them upon a sounder basis and in fitter condition.

There is to my mind another, perhaps a minor, reason for the comparative decrease in railroad building during later years. The promoter has been engaged in other business. The industrial corporation has been the great speculation of the last few years. Our financiers had fairly well saturated the market with railroad securities, but industrial corporations had never felt the buoyant effect of an aggressive policy of exploitation for speculative or investment purposes. The industry of selling securities is applied psychology. It depends upon impression and suggestion. The hypnotist does not throw two ideas into the mind of the same subject at the same time. And so for some years we have found the energy of the interested press and of the "street" put into suggesting this most profitable single thought: "Industrials are the things now." With the result that in ten years we have uttered and sold more industrial securities than had been sold upon all the bourses of the world—perhaps more than were ever issued before. But while we know that the wise promoter plays upon a harp of a single string we also know that he sometimes changes that string. So it may come to pass that upon the slightest provocation or excuse his present sad song as to railroad securities may yet turn into a gladsome outburst whenever this shall become advisable.

It is probably true that as a speculative industry railroading in the United States will not flourish in the future as it has in the past. As a basis for sound investment, however, the hope of the American railroad rests in successful regulation.

And because of the very protection now granted under the law there are some who would urge, with reckless disregard of their own history and experience, an increasing rate of toll with every new rise in value. These unwise and too precipitate gentlemen ask that the government shall by force of law do for them what they could not have done for themselves under the private industry theory, and do it possibly to the demoralization of industry. Wisdom would seem to teach that the transition from the one theory to the other must, for the very welfare of the roads themselves, carry with it no conditions that are onerous and not plainly justifiable before the court of public opinion.

What that future shall be is one of those great problems which must necessarily engage the minds of those who think at all upon this most perplexing and many-sided question, and it is one that turns to no slight extent upon the policy which the government adopts toward the railroads, and upon the policy which they adopt toward the government. This country can not grow without adequate transportation facilities. The railroad is our common highroad; it is not a luxury; it is not a concern in which the farmer and the manufacturer alone are interested; it is an essential to the commercial life of our people, almost as necessary as the land itself. The freight rate determines where we shall mine and how we shall mine; where we shall manufacture and how we shall manufacture; where we shall plant and what we shall plant; what we shall eat and wherewithal we shall be clothed.

Should rates be made merely to meet the needs of the day and every new investment come from a new increment of capital, or should the shipper of today be taxed in some part for the benefit of the shipper tomorrow? To whom belongs the broad margin of profit arising out of superior efficiency, and what should be the standard from which to measure up or down? What share should the community itself have in the growth of values which it in part creates? Questions like these are hidden in the often ingenuous inquiry, "What is a reasonable rate?" And their answer cannot be found in the books but must come from a prescient study of the whole railroad problem.

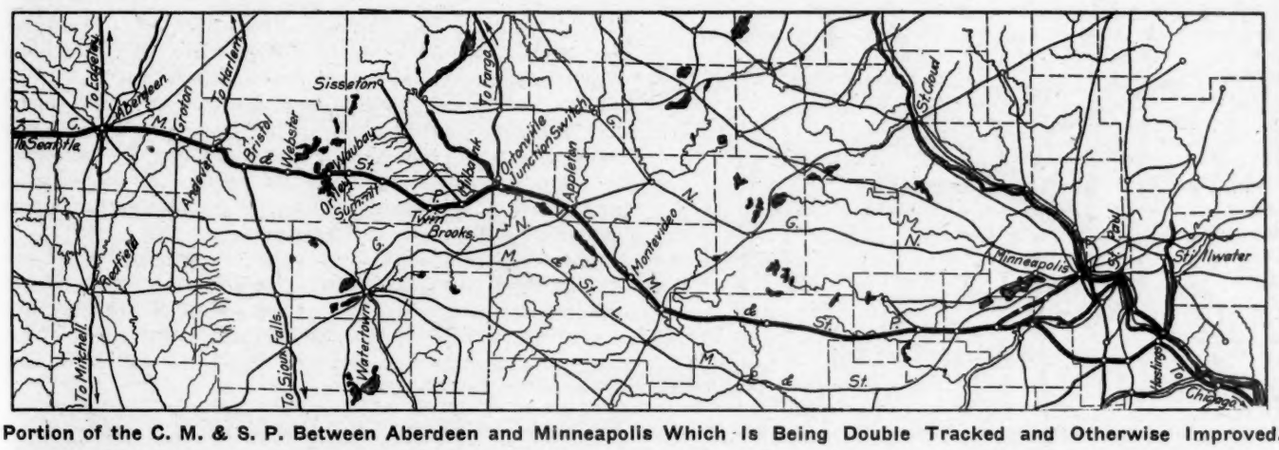
To make regulation a success we must have coöperation—a sympathetic understanding of the direction that must be taken by the shipper, the government, and the railroad man. With the new theory we may hope to see an increasing number of railroad directors who represent the money of the real investor and who give their time to its protection, and of railroad presidents who live at least part of their time upon the line of their own railroads and know the needs of the country they serve and are in touch with its people. In all charitableness it can be said that there has been too close an identity between railroad policies and Wall Street policies. The men who actually operate our railroads, who keep the intricate wheels of this mighty machine constantly in motion and always at our service, receive too little public acknowledgment for the work they perform. They are among the most skilled, capable, and honest of our business and professional men. They have an enthusiasm in their work and a loyalty to their companies that is a constant satisfaction, and their delinquencies too often may be traced to policies which purely as railroad men they would not countenance. With these men we can work, and through them we may hope for the realization of a national system of railroads that will be fair as to rates, profitable as to income, and adequate as to service.

IMPORTANT IMPROVEMENT WORK ON C. M. & ST. P.

Second Track and Grade Revision Between Aberdeen, S. D., and Montevideo, Minn.—Drag Line Excavators Used Extensively.

In line with the policy of the Chicago, Milwaukee & St. Paul of getting its line in readiness for the heavy traffic which the Puget Sound extension and the western feeders are producing in rapidly increasing volume, double tracking and grade and line revision have been undertaken at a number of points on the main line west from St. Paul. On the Hastings and Dakota division about 96 miles of double track east from Aberdeen, S. Dak., have been built during the past season. Work is still under way on other sections between Aberdeen and Montevideo and a short section west of Montevideo was placed in service last year. Between Minneapolis and Montevideo considerable work is under contract. Plans have been made for double tracking the entire distance between Montevideo and Aberdeen. This line was handling during the past summer from 40 to 50 trains per day over single track, and there are abundant indications that the traffic this year will be much heavier than this.

The grades and curves on the old line limited the rating eastbound on this division to 1,600 or 1,700 tons, and only slightly higher than this westbound. The new double track line will be operated with .5 per cent. maximum grades and 1 deg. maximum curves between Aberdeen and Montevideo, and .4 per cent. between Montevideo and Minneapolis. The old line on the hill between Twin Brooks and Summit had 34 curves, some of which were as sharp as 3 deg. 30 min. In the reconstruction work 29 of these curves have been eliminated and the maximum curvature of 1 deg. has been held to. In most cases the new line follows the old very closely, the revisions being confined principally to substituting long tangents for a number of curves. At one point, however, just east of Andover, the new eastbound track has been built on a long loop in order to secure the desired grade. This rather unusual arrangement for a line in a prairie country is shown in the accompanying sketch.



Portion of the C. M. & S. P. Between Aberdeen and Minneapolis Which Is Being Double Tracked and Otherwise Improved.

USE OF DRAG LINE EXCAVATORS IN GRADING.

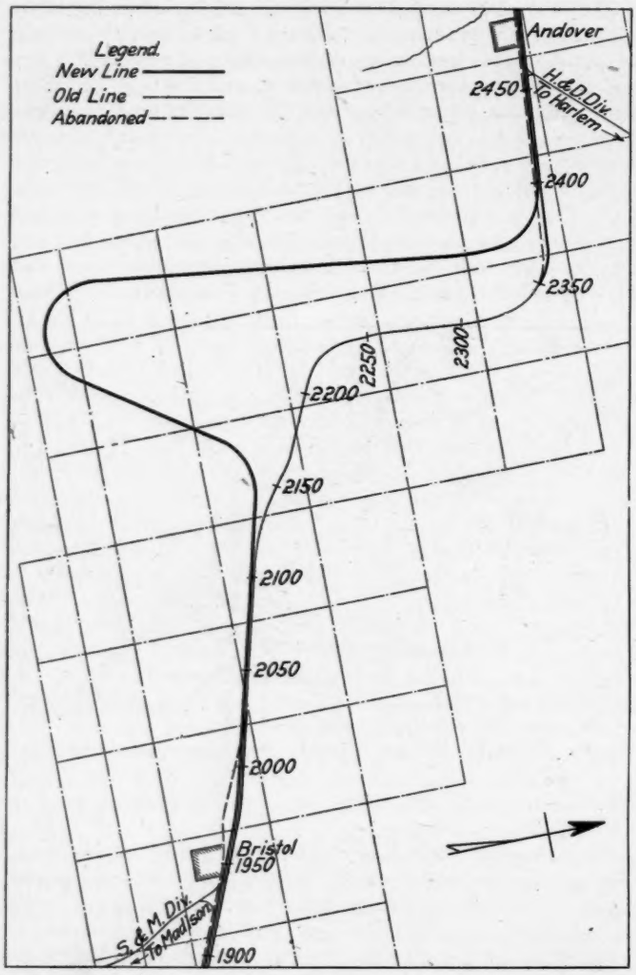
The grading on the section between Aberdeen and Milbank was not exceptionally heavy, amounting to about 4,000,000 yds. The principal interest in this portion of the work is in the fact that the contracts which were handled by drag line excavators were in the aggregate probably the most extensive ever undertaken with these machines in railway construction. The heaviest piece of drag line work was a continuous fill about 4.5 miles long requiring about 900,000 yds., located between Groton and Andover. This work was handled by the general contractors, Morris, Shepard & Dougherty, of St. Paul, using a class 24 and a class 20 Bucyrus drag line. These machines were chosen for this work principally because there was no borrow pit within easy reach where steam shovels could be operated, and also because the material along the line under the top soil was too hard to be handled with elevating graders. The material for the first 4 to 6 ft. consisted of prairie soil, but below this there was an extremely hard grade of shale and hard pan. When the shale was first excavated it was so hard that when struck with a hammer it gave out a ringing tone, but after a few days exposure to the elements it rapidly deteriorated and formed a sticky mud when wet.

The fill was 37 ft. wide at subgrade and varied in height up to 32 ft. As it was necessary that the work be hurried as much as possible, an elevating grader was used to remove the top soil in the side borrow pits which extended 200 ft. from the slope stakes on either side of the fill. The material excavated by these graders was hauled in wagons to the fill and used for building the base to a depth of 10 ft. The smaller drag line then followed on one side of the fill, building up the near slope and filling in the center. This machine was equipped with a 3 yd. bucket and an 85 ft. boom. The larger drag line followed on the other side of the fill, building the other slope and finishing off the grade. It had a 3.5 yd. bucket and a 100 ft. boom, which was long enough to reach the opposite slope of the fill without difficulty.

A small grader, which is ordinarily used for highway work, was kept on top of the fill for leveling and crowning the subgrade. This little machine, which cost only $75, and could be operated with four horses, proved very effective and economical for handling this work. The grader could be set at any height and any angle so that the top of the fill could be very accurately finished. The fills so made were about as clean cut and accurate as are ever seen on railway construction work in this class of material. Both drag lines were required to leave a 5 ft. berm between the toe of the fill and the top of the borrow pit slope. The borrow pits had an average depth of 15 ft. The surface of the ground was level and hard enough to allow the machines to be moved very easily and the width of the pits made it unnecessary to move ahead very far each day; conditions which were very favorable to the economical handling of material by these machines. The only trouble experienced in the moving of the machines was in crossing a 500 ft. ravine which had been filled in with vegetable matter leaving a very soft and boggy surface. To make this unstable foundation safe for the machines, they first filled in about 2 ft. of dry earth as far as they were able to reach, and on this surface was placed a cribbing of ties and 6 in. x 8 in. skidway timbers 14 ft. long. To move the machines ahead the bucket was anchored at an angle of 45 deg. from the direction of

travel in order to prevent cutting up and softening the foundation. By properly placing the rollers the travel of the machine was maintained in a straight line.

When the work was first started the machines were operated with two 10 hour shifts, but later the smaller one was put on three 8 hour shifts. During the early stages of the work the two machines averaged about 1,000 yds. each per shift, but this output was materially increased later. During the month of July, which contained 26 working days, the small machine moved 73,000 yds., and the large machine moved 84,000 yds. During the 18 working days in August, the two machines together handled 130,000 yds. The larger machine averaged 65 swings per hour for an entire month, and for the month of July it made a total of 33,480 swings, the smaller machine

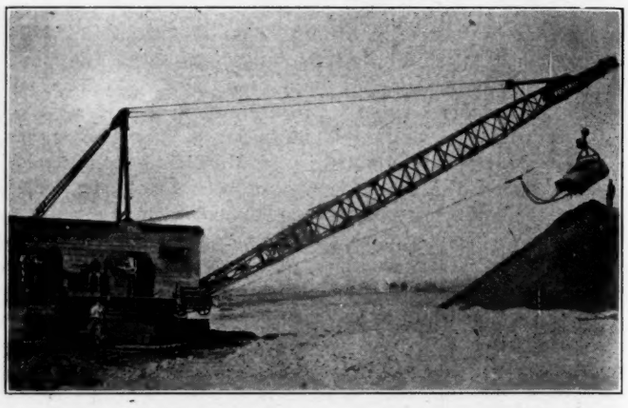


Loop Line Between Bristol and Andover Adopted to Secure 0.5 per cent. Grade East Bound.

making 29,800 swings in the same time. The 900,000 yds. in this fill were handled between June 10 and August 21, about 10 days of that time being lost in getting the machines into operation.

In addition to the engineer and fireman on each machine, there were required from two to six laborers, but there were rarely over ten men employed on both machines. Each machine burned about 6.5 tons of coal in 24 hours, the coal being hauled from a siding near the middle of the section and piled along the line of the work. Water was obtained from artesian wells ranging from 1,000 to 1,200 ft. deep, which delivered it at a head of 30 ft. Considerable trouble was experienced with foaming in the boilers, which an examination showed was due to the large amount of citrate of magnesia contained in this artesian water. The trouble was overcome by mixing crude oil with the water. For introducing this crude oil into the boiler a Detroit lubricator was attached to the boiler in the rear of and below the dome. The steam line leading out of the dome was tapped for the lubricator pipe and the boiler was tapped just above the water line. The condensed steam thus served to force the oil into the boiler. About 3 qts. of oil were used every 24 hours.

Both drag lines were equipped with 3,400 c. p. regenerative arc lights suspended from the boom and eleven 16 c. p. incan-

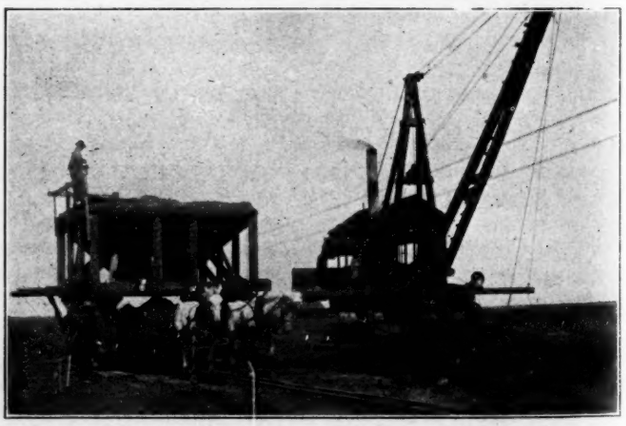


Class 24 Bucyrus Drag Line Making Fill from Side Borrow.

descent lights on the machine. The power for these lights was supplied by a 2.5 k. w. 110 volt generator direct connected to a reciprocating engine mounted over the main engine.

Paget buckets were used on both machines, but it was found that they worked better when the stiff bails were removed and chains substituted. The loose chain seemed to allow the bucket to adjust itself more easily to the surface of the material in which it was working, and it was possible to handle the buckets fuller than with the stiff bail.

Near Waubay another large piece of drag line work was handled by the Callahan Construction Company with a 90 ton drag line equipped with a 90 ft. boom. Most of this work was in a slough, and in order to get rid of the water ahead of the drag pan a ditch ¾ of a mile long, 80 ft. wide and 15 ft. deep



Filling Cars from Hopper Which Was Fed by the Drag Line.

was dug. An 8 in. centrifugal pump was installed to handle the water that collected. Hoy & Elzy handled a sub-contract near Summit with a drag line excavator which dumped the material into cars. Their machine was of their own make, being entirely of wood, and was equipped with a 45 ft. boom and 1.5 yd. bucket. The engine had 7 in. x 10 in. cylinders and the circle on which the machine swung was 12 ft. in diameter. The material was dumped into a wooden hopper holding about 4 yds., from which it could be dropped to horse-drawn cars of one yard capacity. The bottom of the hopper was just high

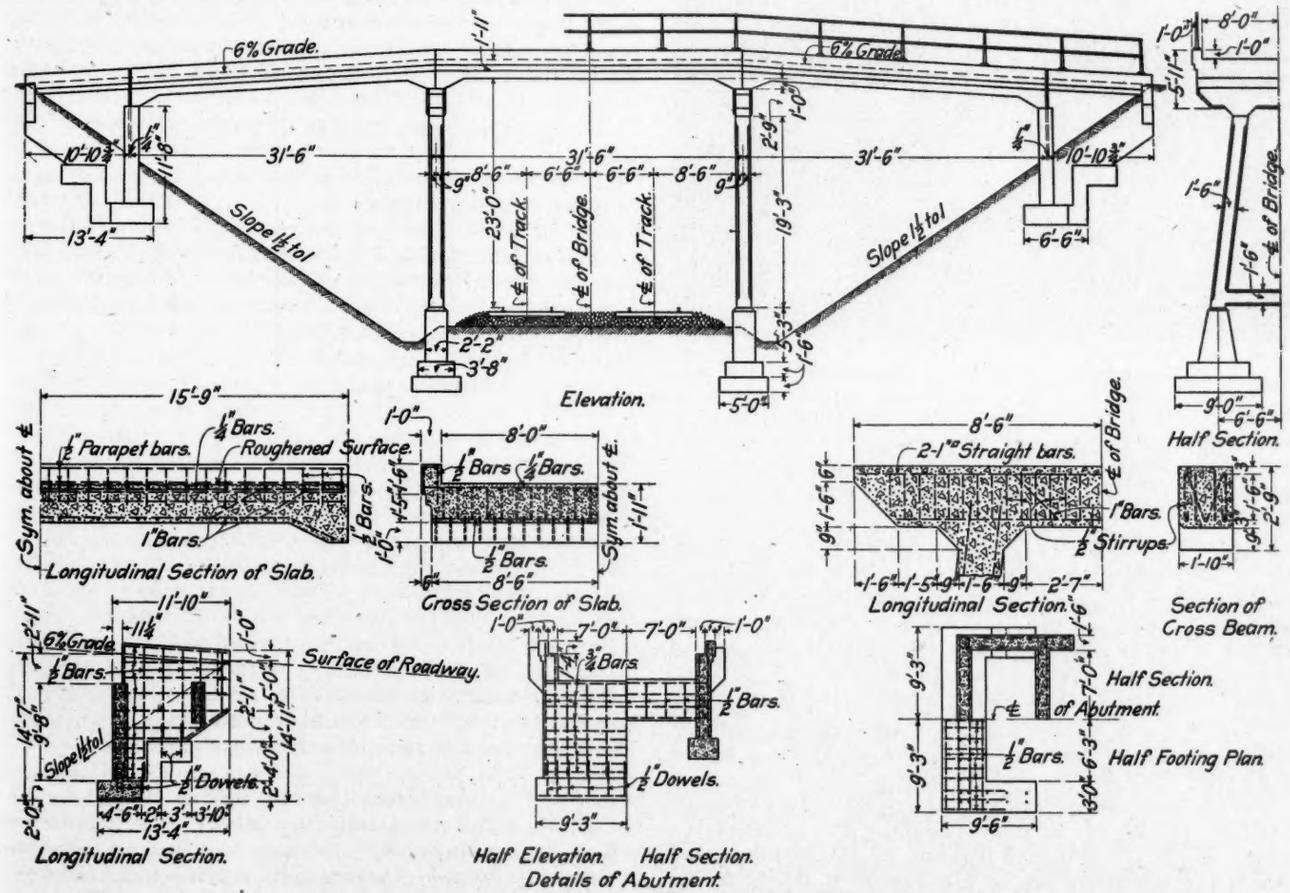
enough to allow a team of horses to walk under it. During the progress of the work it was desired to change the horses for dinky engines pulling longer trains. The clearance of the hopper was not sufficient to operate an engine under it, and on account of the extremely high lift that would have been required to raise the material into a hopper which would clear the engines, it was decided to drop the material directly into the cars. This practice proved very satisfactory, and it was found that the buckets could be dumped closer to the top of the cars than is usual with steam shovels, thereby reducing the drop of the material and lessening the damage to the equipment. Cars of 1.5 yd. capacity were substituted for the 1 yd. cars when the use of the engines was decided upon.

Drag Line Excavator Dumping Directly into Cars.

This machine was handling a very hard cemented gravel which was overlaid with about 2 ft. of loam. Similar material in a steam shovel cut near Ortley was handled without blasting, but it was found necessary in the drag line work to loosen the material with light charges. This drag line worked two 10 hour shifts, using only seven men. One of the best records made was the handling of 68,000 yds. in 30 days. The same contractor operated a Bucyrus drag line of steel construction with a 26 ft. circle, 76 ft. boom and 2.5 yd. bucket, which handled material from a side borrow directly to the fill.

Considerable Light Grading Was Handled by Grading Machines, in this Case Pulled by a Traction Engine.

There were a number of steam shovels used on the work, and the rest of the material was handled by grading machines and team outfits. No unusual features were developed in the handling of these plants.



Details of Reinforced Concrete Highway Bridge Used on the C. M. & St. P.

BRIDGE AND TRACK WORK.

There was no unusual bridge work to be handled, the principal structures being a plate girder bridge over the James

river and a concrete trestle bridge to take care of the overflow of the James river. This trestle is of the standard type used on the Milwaukee lines, having four 16 ft. spans carried on bents of 10 hexagonal concrete piles capped with a reinforced concrete cap 2 ft. 10 in. wide and 3 ft. 6 in. deep. The slabs had a uniform thickness of 3 ft. 6 in. Cast iron or concrete pipe was used for culverts in sizes up to 48 in. Concrete box culverts were used for larger drainage openings. All of the concrete work was handled by company forces under the engineering department. One typical 6 ft. x 8 ft. box culvert, 80 ft. long contained 200 yds. of concrete. Although most of the concrete was mixed and placed by machinery, this particular concrete was hand mixed, being placed in four working days by a foreman and 15 men. The labor cost for the structure was $700.

Wherever possible, separate grades for highways were provided. In most of these cases the road is carried under the tracks in slab top concrete structures varying in size from 20 ft. x 13 ft. to 28 ft. x 16 ft., the barrels being limited in length to 35 to 40 ft. When overhead structures were required they were usually built of timber, but in some cases where the locations were permanently established and there were no changes likely to be made, concrete structures were used. The reinforced concrete bridge which has become standard on the Milwaukee for such overhead crossings consists of three floor slabs of 31 ft. 6 in. spans carried on two column bents and two especially designed abutments. The two column bents of reinforced concrete have 1 ft. 6 in. square columns battered about 1 to 7.5 and tied together just above the footings by a reinforced concrete tie 1 ft. 6 in. square. The floor slabs have a minimum depth of 1 ft. 11 in., and can be used on grades up to 6 per cent.

Trestling for One of the Highest Fills.

At Andover, Bristol and Summit, small yards to care for 200 or 300 cars each, are being provided. Andover and Bristol are junction points with branch lines, and Summit is at the top of the grade where it will still be necessary to store a considerable number of cars at times. A new terminal yard is being built at Montevideo, with a capacity of about 1,000 cars and a yard with fifteen 3,500 ft. tracks; a 30-stall roundhouse, and shops are already in service at Aberdeen. Passing tracks 4,000 ft. long are being provided for both eastbound and westbound trains at about every other station, or at intervals of 15 to 20 miles.

The standard roadbed width for fills is 35 ft., for heights up to 20 ft., and 37 ft. for greater heights. The corresponding widths in cuts are 39 and 43 ft., using 1.5 to 1 slopes in both cases. The new tracks will be laid with 90 lb. rail on fir ties with tie plates. Gravel ballast, obtained from a pit near Wauby is being used.

This construction work is being handled under the direction of C. F. Loweth, chief engineer, W. H. Penfield, assistant to the vice-president and formerly assistant chief engineer, and T. H. Strate, construction engineer in direct charge of the work, to all of whom we are indebted for courtesies extended in connection with the securing of the above information.

REPORT ON WAREHOUSE POINT COLLISION

The Public Utilities Commission of Connecticut has issued a report dated February 8, giving the conclusions of C. C. Elwell, chief engineer of the commission, on the causes of a collision which occurred on the New York, New Haven & Hartford, at Warehouse Point, January 10, about 8 p. m. A north-bound express train was flagged near Windsor Locks. The flagman belonged to extra freight No. 368; and when he reached the next side track and saw a freight standing there, he got off from the engine of the express, and then signalled to the engineman that all was clear. But this proved to be another train, No. 368 having gone forward to the next station. At that station, before it could be set off, the freight was run into by the passenger. One person was injured slightly. The conductor of the freight ran back to stop the passenger train but was not soon enough, there being a sharp curve in the line. The immediate cause of the collision was the failure of the engineman of the express to watch carefully for an automatic block signal which stood on this curve. There is no distant signal for this block signal, and as the curve turns to the left it is customary to depend on the fireman to read the signal. It is visible to him for only a few seconds. A switch, quite near the signal, is visible about the same time. The fireman in this case thinks that he must have mistaken the switch light for the signal light. The inspector says that neither of the two freight trains had lights burning in the cabooses to illuminate the indicator showing the number of the train, and this he calls the primary cause of the accident. The block signal so near the switch is declared to be blindly located. He recommends more careful attention to the indicators in the cabooses; that a distant signal be provided for the home signal referred to, and that prompt consideration be given by the railroad to the removal of all banjo signals on the main line.

REPORT ON DRESDEN COLLISION.

The Interstate Commerce Commission has issued a report made by Chief Inspector Belnap, dated February 18, on the rear collision at Dresden, Ohio, on the Pennsylvania Lines, December 3, last, when passenger train No. 43 ran into the rear of passenger train No. 125 which had been unexpectedly stopped; and 9 passengers and two employees were killed and seven persons injured. The collision occurred about 6 p. m., when it was quite dark, but clear. The trains had left the last preceding station five minutes apart, which is the minimum time interval prescribed by rule 91. The flagman of No. 125 is said to have gone back promptly, walking a part of the time, and part of the time running; and he probably reached a point about 1,000 ft. to 1,200 ft. back of his train when he was passed by train 43. The engineman of train No. 43 could see but a short distance, but the fireman could have seen the tail lights of the standing train about 1,500 ft. off, had he been looking out, but he had been putting coal into the fire just then. Train 43 was running about 50 miles an hour, or faster, though a rule on the time table limits the speed of trains on this part of the road to 40 miles an hour.

The inspector calls the inability of the flagman to get back a sufficient distance the direct cause of this collision, and he says that the time interval should be greater than five minutes. The brakeman is held responsible, however, for not taking fusees with him. These he keeps in his train box, in the smoking compartment of the car, instead of having them at the rear end of the car, where they would be quickly available. Had he put down a fusee the engineman of No. 43 might have seen its reflection in time. The conductor is blamed for not seeing that the flagman had all of his stop signals ready for use in case of emergency. The engineman of No. 43 is held responsible for running too fast, but on evidence of employees it is decided that this speed limit rule is not generally observed. The trouble on the leading train was the breaking of the pipe which supplies air to the air whistle signal. This pipe had been reported, the day before, as needing repairs, and the inspector censures the road for not keeping the engine in proper condition.

IMPRESSIONS OF EUROPEAN RAILWAY PRACTICE.

Training of Employees and Careful Selection and Design of Material Are Given More Attention Than in This Country.

By Henry W. Jacobs.

To the motive power man the railroad systems of Europe present an aggregate of about 100,000 locomotives of all sizes and kinds, compared with 60,000 in the United States, and operating over a railroad mileage somewhat less than the mileage of the United States. Railroads have been in existence in Europe even longer than in this country, and, naturally, in the development in each country, the special genius of each people has developed particular excellence in one respect or another; many of these features are pregnant with examples that America might well follow, or at least study and consider most carefully.

The superiority of European railroad mechanical methods generally may be classed into divisions, training of personnel, and selection and design of materials.

In the treatment of the employees in the shops and in locomotive running service, the training is longer and more thorough and careful than it is with us; and this training has as its objective a more definite preparation for the predetermined vocation of the man.

APPRENTICE TRAINING.

For the service of the locomotive and car shops, for instance, apprentice courses and schools in connection with the works or shops are established in all of the countries, with the result that each succeeding generation of mechanics finds men not less skilled than their fathers, but on the contrary, equally as well trained in practical work and with a far better understanding of the technical aspects of the continued improvement in mechanical methods.

The apprenticeship courses are almost equivalent to some of our institutes of technology in the technical groundwork of instruction imparted; and at the same time, by having the young men devote the majority of their time to practical shop work, often in shops especially set aside for the purpose where certain classes of material, such as small locomotive parts and shop tools are made requiring the most accurate workmanship, they become practical skilled mechanics. Such pioneers as George M. Basford in this country, who gave much time and effort in trying to awaken a similar interest in our shops, cannot be too highly commended.

In America we cannot be said to train men that they may be fitted as mechanics. The young man does not set out consecrated, as it were, to the high calling of producing work mechanically and beautifully without flaws. He sets out rather with the desire to get through his journeyman and mechanic days as hastily as possible that he may the sooner be an inventor or a shop superintendent, instead of the consummation of his ambition being the perfection of his skill; such skill as he might acquire is consumed by his ambition. This is a price we are paying for democracy, and our industrial efficiency is footing the bill. We must admit that in this aspect they do things better abroad, where the devotion of a life to the service of a (mechanical) calling is still a live and honored tradition.

The enginemen receive similar careful training for their posts, having to go through a certain amount of shop experience, which gives them a knowledge of the machine they are to run and influences their attitude toward the careful nursing and treatment of that machine when it is entrusted to their care. The result of this attitude is on the one hand to keep the engine at all times in the best working condition, and on the other hand to get from it the maximum possible efficiency. By these methods of training, and also by the provident welfare and benevolent institutions, which find their highest development in Germany, the men fit naturally into a life work and position, and in these positions they are given opportunity to remain.

When the men are in the service their moral welfare continues to be the subject of a kindly paternalistic administration. The soda fountain established in the Budapest shops has been mentioned and furnishes the germ of an idea which may well be adapted to our uses in America. Whether we belong to a prohibition or total abstinence movement or not, we are all agreed as to the evil effects of alcoholism, as to the benefits of temperateness, and it is interesting to note in this connection that American railroads have probably done more (by stern discipline in enforcing Rule G) in the cause of practical temperance than have the political movements to this end. In the extirpation of an evil, we should seek its root. Why is a saloon? The saloonkeeper long recognized that he could not alone draw his trade by selling alcoholic drinks, but to keep and hold his customers he would have to give them good service. For that reason he gives the whole and hearty cheer, the wayside warmth and companionship to the lonely shop or workmen, as in the inn of old, and with practical concession to modern business needs, uses, etc. In the saloon the quickest and cheapest of lunches may be had. Every saloon is (for men) a public comfort station. The barkeeper is the working shopmen's banker, in many instances where his pay-check is cashed without inconvenient red tape, and if the workman is his customer in good standing and needs a dollar or five, he gets it. The saloon in America has made itself a public service institution—not confined to the hours 10 to 3.

How different might our workmen's life here be if the soda fountains had set themselves to give the same service as the bars—if they were such representative servic institutions. In this we have the idea of our R. R. Y. M. C. A.'s—the true way, as the writer has already elaborated in an earlier book, to confirm men in moral habits; and when we add to the moral influences the growing utility of these Y. M. C. A.'s and recreation clubs such as Mr. Ripley of the Santa Fe has instituted, the railroads are developing a public service of the highest order, one deserving even of being fostered by government support, as is done in similar instances abroad.

Not only are the employees carefully prepared for their respective trades, but the engineers who are to design the locomotives, machinery and other paraphernalia of railroad operation are trained with a view to close working limits of the materials employed. Attention is paid to the quality of the material—that it should be of the best for the purpose in view, and that all parts, for instance of a locomotive, shall be as light and small as is consistent with strength because of the limitations as to wheel loads and clearances. For these reasons greater attention is paid to the nature of the metal entering into cylinder and other castings, into rod and other forgings, and to the reduction of the thickness of the walls and other sections to a minimum; and also to the most careful heat treatment and subsequent testing of all parts so as to eliminate internal stresses in the material.

In view of this great care both in design and in selection of material, the locomotive parts are not generally subject to such heavy working stresses and fewer engine failures take place due to breakages of frames, rods, blowing out of cylinder heads, etc.

FISCAL POLICY.

The fiscal policy of the roads abroad with respect to the personnel, particularly of the shops, is such as to provide an

even average of working hours and working output. The necessary financial reserves are maintained for this purpose irrespective of the current high or low tide of traffic receipts. The general policy of a great many of our railroads is to curtail the shop forces and hours whenever a business depression sets in, which has unfortunate results in the disorganization of the working forces, bringing about the loss of many good workmen, and tending to make our mechanics unsettled and causing them to drift from one branch of work to another.

None realize the drawbacks of this policy better than our operating officials themselves, and the necessary financial support should be given to the changes in this procedure that they would be only too eager to bring about. The annual result would increase the net earnings of the roads as compared with the losses entailed by the present practice, as well as give better service and operating conditions. I have been told by men in charge that in the last two years the policy of retrenchment which is very frequently followed to curtail expenses at the close of the fiscal year, had the same effect on the momentum of the work in progress as the continual stopping and starting of a flywheel would have on the even running of a steam engine.

CONSERVATISM OF EUROPEANS.

I had often heard of the ultra-conservatism of Europeans in adopting changes, but I must confess that my personal observations inclined me rather to the opposite view. I found European engineers and shop officers only too ready to accept changes in existing practice that could be shown to be an improvement. For instance, their new shop layouts are well designed and the most modern machinery is installed, some of it, as stated, coming from America. Roundhouses are modern in construction, such details as power driven turntables (even with the smaller locomotives used abroad), efficient ventilation, etc., being given attention. In modern improvements in locomotive design, we must give Europe credit for making the fullest practical use of superheaters, compound and multi-compound engines, tank engines for all classes of service except the heaviest long-distance through express and freight trains; and we should not ignore the practical conservation resulting from the general use of briquetted fuel.

MANUFACTURE OF MATERIALS AND EQUIPMENT.

In another respect, however, a tendency that was not so good, considered economically, either with reference to the railroad operation or the welfare of the industrial community, impressed me very strongly. I refer particularly to conditions obtaining in England. This tendency was towards the manufacture of all kinds of material used in railroad construction and operation at the company's shops, turning the railroad into a very large manufacturing concern. The result of this policy on the part of the English roads is that the locomotive building industry there has received so little encouragement that it is placed at a great disadvantage in maintaining plants for the supplying of engines for the British colonies and for export to other countries in competition with some of the great continental locomotive works. The same condition holds true with regard to the rolling of steel rails, the building of cars, etc. This is a policy we should avoid following to too great an extent in America, as railroads are, and should primarily confine themselves to being, a transportation enterprise.

The manufacturing business presents entirely independent and different problems, and can be handled quite as well, if not better, by individuals or companies devoted to the special kind of manufacture in question than is feasible by the large organization of a railroad whose directors and principal officers are primarily concerned with the securing and handling of traffic and the financial problems involved.

A manufacturer of an individual article, such as a bolt for example, has to devote the greatest attention to that article to see that both its quality and its price enables it to survive as a product under competitive conditions. The manufacturer of bolts must make each bolt produce its share of profits or dividends; a railroad company, on the other hand, being organized for the production of transportation and not for the manufacture of materials, has no direct or competitive incentive to make each bolt pay a dividend or be of such design and quality that it may compete (in its efficiency as a bolt) with the kinds of bolts used by other railroads. Marked and indirect advantages accrue from leaving manufacture to concerns especially equipped therefor, since not only can the work be produced as cheaply or more cheaply, with all the overhead charges included, and as well or better than can be done by the railroad shops; but also the employees' families, and the financial supporters of these factories, are drawn into an attitude sympathetic with the railroad enterprises instead of being indifferent as to its welfare. Also the labor position of the railroads is much improved, since an association of employees, that can make a simultaneous demand for an entire railroad system, will be split up among the different manufacturers and trades supplying railway materials, leaving to each industry the handling of its own special labor problems and requirements.

It is well recognized in America that some of our stupendous organizations, employing tens or hundreds of thousands of men, have become unwieldy in their handling of questions relating to the personnel, owing to the physical impossibility of a single man at the head deciding upon all matters; and on the other hand a tendency to take away the power of decision from subordinate officers and officers in direct relation with the men and the questions concerning them. In the past, in smaller concerns, where the employer was in direct touch with his men and with the conditions of the industry, the working condition of the men and the attention given to the character of the product was more satisfactory and gave rise to less discontent, both on the part of the workers and on the part of the users of the materials, than is wont to be the case where the activities are carried on as part of a vast corporation.

Our Railway Business Association has done much to calm popular clamor for the unreasonable in railroad legislation and to counteract a tendency toward drastic rate cutting by government commissions. This organization, although unasked, took the side of the railroads in the recent period of stress, and by its makeup was able to accomplish much that the railroads themselves could not do. Its membership is made up of the largest and strongest, as well as numerous minor concerns, scattered over the land from coast to coast. All members are active allies of the railroads. Their influence through their thousands of employees, permeates and affects public opinion in a way impossible for any other organization. When one considers what this one organization, friendly to the railroads, has done, the advisability of taking work from such concerns and performing it in railroad shops becomes questionable; in fact it seems as if railroad friendships should be built up even more among outsiders by increasing the list of those from whom we purchase and the list of articles purchased. Some roads, however, seem to be going in the other direction and are inclining toward the English practice in this matter.

OPERATION OF EQUIPMENT.

Besides the conditions under which the equipment and other materials of a railroad are produced, there is much that is instructive to us in Europe's example in the operation of this equipment. Reference has already been made to the few engine failures, which, for instance, on the Prussian state system, are of such rare occurrence that it is not necessary to make of them a matter of daily or hourly report with continual irritating criticism of officers and men. Of course, reports are made of engine failures when they occur, but these are due almost entirely to some exceptional and unavoidable accidental cause, failures due to wear or weakness of the locomotive parts being corrected as to causes before a failure on the road can take

place. This precaution is exercised by the most careful roundhouse inspection, both on the part of the engine crew to whom the engine is assigned, and on the part of the inspectors charged with this duty. This care in keeping the engine in condition results in a smoothness and reliability of working that is indeed enviable.

OPERATING ECONOMY.

Mention has also been made of the economy of the European locomotives in fuel and steam, this economy commencing with the design of the locomotive and ending with the personal interest of the engineer and fireman and the supervision given to their individual performances by the motive power and transportation officers. Despite our abundance of cheap but excellent coal in America, our fuel bill constitutes such a large percentage of railroad operating cost that we surely should be no more sparing in pains and effort to bring this fuel consumption to a minimum than have been the Europeans.

In view of the several respects in which the European railroads are excellently maintained and operated with closest regard to excellence of service and detailed attention to economy in repair and operation, it may be wondered why European railroads are not more profitably run than are the American roads. While abroad I gave my attention to the practical shop and locomotive aspects of the roads, rather than a comprehensive study of their financial and fiscal arrangements and conditions, but as far as I could gather from the published statistics available in these latter respects, and from conversations with the higher railroad officials, the greater first cost of the railroads in Europe, due to their having originally been built through thickly settled regions where the right-of-way had to be acquired at a high price from private concerns, has imposed upon the roads abroad fixed charges much greater in proportion to the volume of traffic than obtains with us. Another influence is the small clearance of locomotives and cars, and the consequently short train lengths, these limitations having their origin in the fact that the early railroad equipment comprised carriages and wagons transferred from the highways to the metal railed tracks by providing them with flanged wheels and pulling them by a steam locomotive instead of animal traction. With the extension of lines, the early wagon wheel gage, distance between double tracks, sections of tunnels and cuts (often walled so that the least width of strip of land necessary would have to be purchased) were not increased, and it was not considered necessary in view of the greater cheapness of steam railroad haul compared with the previous traffic for the roads. The reason we have employed larger clearances in America is that we were fortunate in building our railroads through a thinly settled and comparatively undeveloped country where the land cost was not so serious a problem.

Since coming back to my native home, I have wondered over the contrasts, the differences that have arisen in so many details in Europe and America, and I am most weighed down by the difference in the way the European and the American view the human aspects of the rail transportation problem. We have dealt with certain aspects of the employee—his selection, his formative period, his security in the enjoyment of the fruits of years of service. These methods are in distinct contrast to "the individualistic shift for yourself free American melee," which has finally crystallized in making our unions so strong—strong because they furnish the channel through which workmen have become more secure in their positions. How often have we seen workmen lose their positions due to the fact that some gang foreman was tyrannical and wished to exercise the power to which he had recently been promoted.

The contrast in the attitude toward and by the public is equally striking. Rates and bases for them typify such relations. In England and America rates have arisen almost entirely out of competitive activities between either routes or localities. Certain maxims have been established by law. On the Continent, and particularly in Germany, an attempt at a scientific kilometric-plus-terminal charge classification has been attempted, governmental control of this matter being similar to the aim of our own Interstate Commerce Commission legislation and decision today. The result in Germany has been devious, as exceptions to the flat or zone tariffs; certain commodity rates existed when the new scientific plan was adopted. Under these exceptions or "Ausnahume" tariffs most of the German freight of today moves more pliant to traffic growth than with the rigid so called scientific method, which has correspondingly diminished in proportion to traffic moved.

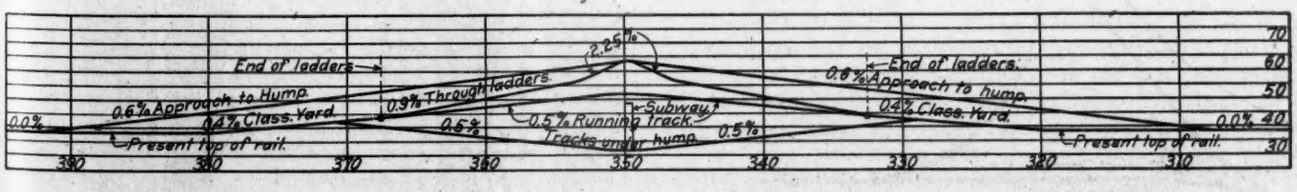
Strangely enough, however, nowhere abroad do we see any indication of an attempt to base rates upon physical valuation of the property used to effect transportation. This is a new shibboleth that has raised its head in our land, and that is destined to wander a tortuous course; we cannot but wonder what will be the effect on two roads of different construction standards between the same termini, or two roads of similar construction, but different operating conditions?

NEW CLASSIFICATION YARD AT CHICAGO.

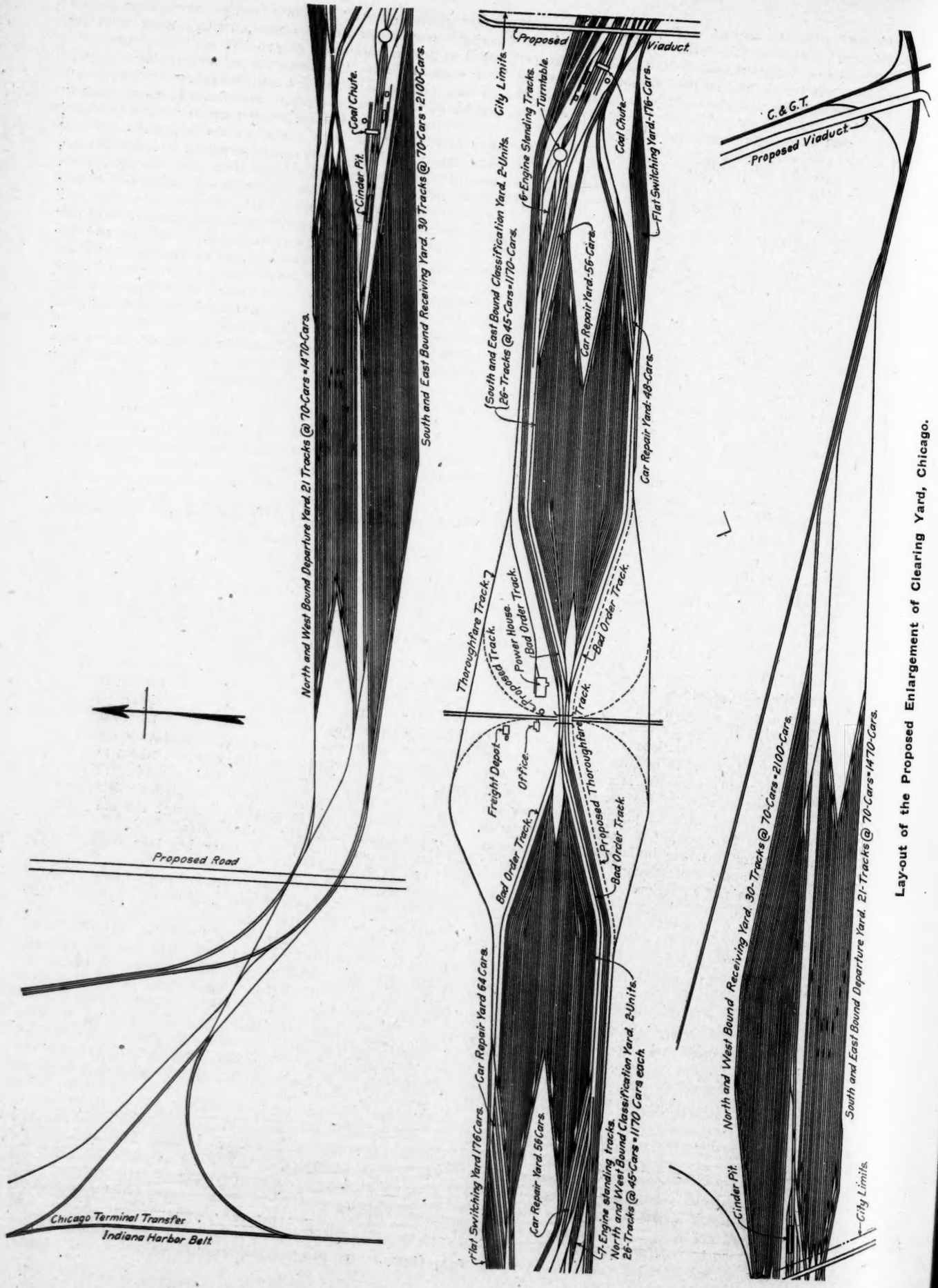
Preliminary plans have just been announced by the Belt Railway of Chicago, showing the nature of the improvements and additions to be made to the Clearing yard, located in the southwest portion of Chicago, as outlined in our news column last week. The original Clearing yard was constructed about 12 years ago by the Chicago Union Transfer Railroad Company, and at the time it was built it was the largest of its kind. Two classification yards were built, one on each side of the hump over which were carried two tracks, one for use in each direction. Small receiving yards were located on the lower level at each side of the hump, but no departure yards were provided, the classification yard serving also as a departure yard. The approach tracks to this yard were so located as to cross each other at grade. This feature combined with others, resulted in considerable delay and interference with train movements, although the old yard has only been used to a very limited extent.

Until recently the Belt Railway has been owned by the Chicago & Eastern Illinois, the Erie, the Grand Trunk, the Wabash and the Monon. As mentioned in the issue of March 22, 1912, page 693, seven other roads, the Burlington, the Chesapeake & Ohio, the Illinois Central, the Pennsylvania, the Rock Island, the Santa Fe and the Soo, have each purchased an interest in this road. The Belt Railway has also recently purchased the Chicago Union Transfer Company, including its real estate and the present hump yard at Clearing. New plans have been prepared for the rearrangement and extension of this yard, as shown in the accompanying drawing.

In order to take advantage of the property already owned and to utilize as far as possible the work already done, the classification yards on each side of the hump have been re-



Profile Over Hump.



Lay-out of the Proposed Enlargement of Clearing Yard, Chicago.

tained, but each has been separated into two yards, each yard leading to its own track over the hump. This yard will serve as a clearing or interchange yard between the various owning roads, and the interchange traffic of each road will, in most cases, be practically all in one direction, although some of the southern roads, as the Illinois Central, for instance, will deliver cars to this yard for connecting lines both east and west. Cars delivered by the eastern lines will be brought into the yard from a connection with the Belt near the Grand Trunk crossing at Hayford. Traffic from the western roads will be delivered at the western end of the yard over the four-track connection from the north, which will swing around parallel to the yard and connect with the Belt about a half mile north of the yard. In this way all traffic will pass through the yard in the direction of its final travel, eliminating reverse movements. This interchange business will all be brought into the yard by the individual roads with their own power, moving over the tracks of the Belt Railway from their various connections.

The receiving and departure yards at both ends will be entirely new. Each receiving yard will consist of 30 tracks of 70 cars capacity each, while each departure yard will have 21 tracks of the same length. The classification yards will each contain 52 tracks holding 45 cars each. One unusual feature worked out in the design of this yard is that providing for four tracks over the hump, enabling this number of trains to be classified at one time. Each hump track is provided with two approach tracks, while the two hump tracks in each direction are connected with crossovers, enabling cars from either track to be sent to any classification track. Arrangement is made for communication between the two sides of the yard by a track passing under the hump.

It is proposed to operate the switches at the ends of the classification yards next to the hump from an interlocking tower placed on the hump. Provisions will be made to light the yard by electricity and to provide means for the proper return of the car riders to the hump. Compressed air will be carried into the departure yards as well as into the repair yards. All power required for various purposes will be generated at the powerhouse, already completed and located near the hump. A coal chute, water tank, cinder pit and turntable will be provided between the classification and the receiving and departure yards at each end.

Work has already been started on this extension and it will be pushed as fast as weather conditions permit. It is aimed to have the yard completed for service late in the present season. Over 1,000,000 cu. yd. of grading will be required to provide for the additional tracks.

When completed, the yard and its approaches will contain about 150 miles of track, while the car capacity in the receiving, classification and departure yards, exclusive of ladders and thoroughfare tracks, will be between 11,000 and 12,000 cars. The plan shown is considered as a first unit and has been designed with a view to the construction of additional units with a minimum interference at any time when the business demands.

In designing this yard the principal ideas kept in mind were: to separate incoming and outgoing business at each end as far as practicable; to provide receiving and departure yards so located with reference to the classification yards that the progressive movements of the cars tended to move them in the direction of their final destination; to bring the points where inbound engines cut off into close proximity with engine terminal facilities and convenient to the departure yards, and, in fact, to enable all movements within the yard to be performed by yard engines so that the transfer engines may be enabled to depart with the least delay and interference to yard movements.

This work has been designed and will be carried out under the direction of E. H. Lee, chief engineer, Chicago & Western Indiana and Belt Railway, who is chairman of an advisory committee of engineers of the proprietary lines, the other members of which are A. S. Baldwin, chief engineer, Illinois Central; J. B. Berry, chief engineer, Rock Island; W. L. Breckenridge, engineer maintenance of way, Burlington, and R. Trimble, chief engineer, maintenance of way, Pennsylvania lines west.

LIGHTING FIXTURES FOR POSTAL CARS.

The results of the exhaustive tests made on a Baltimore & Ohio postal car at Washington during the latter part of last year and the recent specifications for lighting postal cars issued by the post office department are described elsewhere in this issue. The Safety Car Heating and Lighting Company has developed a new line of fixtures for this class of service.

Where the Pintsch lighting system is used, it was found desirable to use a type of metal reflector that would distribute the light properly on the letter cases, bag-racks and paper boxes without a wasteful use of the light on the ceiling and other parts of the car where it was not needed in the distribution of mail matter. Two types of aluminumized steel reflector units have been developed, one for letter case lighting and the other for bag-rack, paper box and storage lighting. Both of these reflector units are made to fit the standard Pintsch mantle lamp, and not only give the required illumination at all points in the car but, by a careful distribution of the light, economize on the gas consumption. The reflector unit shown in Fig. 1 is designed for use on Pintsch lamps in the center of the car to light the bag-racks and paper boxes as well as for general illumination in the car. The characteristic light distribution curve of this reflector is such as to make the labels at all points in the bag-rack and storage portions of the car very distinct.

The reflector unit shown in Fig. 2 is designed for use at the letter cases and its characteristic light distribution curve is such as to insure ample illumination on the horizontal reading plane as well as on all the letter case labels. The conditions of letter case lighting are such as to require careful study in the design of a reflector to meet the requirements, and without extreme care the lighting at some points on the letter case labels is very apt to fall below or above the specifications.

Figs. 1 and 2—Bowl Units for Pintsch Mantle Lamps.

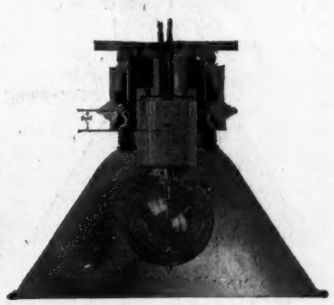


Fig. 3—Shade Holder and Adjustment for Electric Lamp.

This reflector meets these requirements in all cases and allows an ample margin for depreciation. With the standard postal car construction adopted by the post office department, the mounting height of Pintsch mantles should be 7 feet 7 inches from the center of the mantle to the floor of the car, and two different types of mantles are recommended for use with these reflectors.

For electric lighting the government has allowed a wide latitude in the use of lamps and reflectors, and the development of a universal type of lighting fixture has necessitated careful study of all conditions. With different spacing of the light units, any of the standard electric train lighting lamps can be successfully used. Considering the metal reflectors alone, it is necessary to provide a fixture that will give a variety of mounting heights considered in the relation of the top of the reflector to the base contact of the electric lamp. A reflector is designed to meet certain lighting requirements by providing a characteristic light distribution curve when the center of the light source is in a certain fixed relation to the reflector, and it is on account of the variable position of the filament, in different types of electric lamps of different shapes and different wattages, that different heights of the base contact of the lamps in relation to the top of the reflector must be provided for in any universal lighting fixture. As in the case of the Pintsch mantle lamp, the light should be distributed where it is needed for the distribution of mail, and not wasted to light the ceilings of the car. It is claimed that the aluminumized and enameled steel reflectors are most satisfactory for this purpose, since they distribute the maximum light downward and in addition are practically free from the danger of breakage. The Safety Car Heating and Lighting Company has selected five types of steel reflectors for postal car lighting, of which that for letter case lighting is shown in Fig. 3. This is intended for all types of electric lamps used at the letter cases. To provide for the use of these different types of lamps and reflectors, six different positions of the base contacts of the lamps in relation to the top of the reflector must be available, and a shade or reflector holder has been developed on the principle of the safety shade holder, wherein a practically universal adaptation to any of these types of reflectors or lamps is obtained. The variable mounting height of the lamp filament in the reflector is taken care of by an extension member or socket support inside of the shade holder, while all the other parts of the shade holder are interchangeable for all conditions of postal car lighting. These shade holders are made to attach to the base and stem of a fixture designed to give the correct height from the center of the lamp filament to the floor of the car according to the requirements in the government specifications. The bases of these fixtures are made with either one or two outlets for either ½-in., ¾-in. or 1-in. conduit, and provide for an easy and accessible method of conduit wiring inside the car. This universal type of shade holder is also adapted, without change in its construction, to the many types of Crouse-Hinds condulets occasionally preferred by the engineer in installing his electric wiring.

The feature of universally adapting a fixture for every requirement in postal car lighting is of immense advantage to the operation of car lighting, since it provides for future developments in electric lamp manufacture or for a change in the standard types and sizes of lamps in use on the railway having these fixtures already installed. These fixtures use the most approved type of electric lamp sockets having a substantial spring base contact and heavy insulation. For the convenience of railways ordering lighting fixtures for postal cars, the Safety Car Heating and Lighting Company has prepared a table of the lamps, reflectors, and types of holders which may be used to meet the government specifications.

Fig. 4—Universal Electric Lighting Fixture for Postal Car Letter Cases.

Fig. 5—Universal Electric Lighting Fixture for Bag Racks, Paper Boxes and Storage.

Fig. 6—Universal Electric Lighting Fixture for Letter Cases in Apartment Cars.

Construction of Light Railways in Argentina.—The government inspector supervising the construction of the light railways in the province of San Juan has reported to the government that progress on the construction of these lines is very slow. He states that the branch to Marquesado is finished and that with respect to the circuit from San Juan to Santa Lucia the buildings, earthworks, sidings, and telegraph have been finished to Santa Lucia, and this branch has just been opened. The branch from Caucete to Albardon is progressing very slowly, earthworks are finished to kilometer 18, and wiring on both sides of the line is complete to that distance. He states that this branch is of great importance for the commercial and agricultural development of this important zone.

General News.

A message by wireless telegraph sent from Key West, Fla., recently was heard at Cairo, Egypt, about 7,000 miles away.

The United States district attorney at Chicago filed a bill in the district court on March 13, to recover $6,200 in penalties from the Illinois Central for violations of the federal hours of service law.

The Department of Agriculture reports that the losses by fire in the national forests during the year 1912 were lower than for many years. The total is estimated at $75,290. The aggregate number of acres burned over was 230,000, as compared with 780,000 acres in 1911.

A letter from the president of the Pennsylvania Railroad to the governor of New York, protesting against the adoption of a full crew law, is given in another column. The presidents of the New York, New Haven & Hartford, the New York Central and the Erie have sent similar letters to the governor.

The postmaster general reports that the number of parcels carried in the mails during the month of February was about fifteen million, or 50 per cent. in excess of the number carried in January. The number mailed in Chicago was 5,167,540 more than a million greater than the number sent from New York, which showed the next largest record.

About five hundred men working in the track repair department of the Pennsylvania Railroad in New Jersey struck and left their work last week. Two hundred electrical workers of the New York, New Haven & Hartford struck March 17, demanding higher pay and better conditions. These men are repair and maintenance men on the electric-traction section of the road, west of Stamford.

Another new passenger train is to be put in service on April 1 by the Chicago & North Western and the Union Pacific between Chicago and San Francisco in addition to the new extra-fare "Overland Limited." It will be called the San Francisco Limited, and will leave Chicago daily at 8:30 p. m., arriving at San Francisco at 8:50 p. m., the third day. Eastbound it will leave San Francisco at 11:40 p. m., arriving in Chicago at 8:30 a. m.

A press despatch from Washington, purporting to give the utterances and views of Interstate Commerce Commissioner McChord, says that orders have been issued to safety appliance inspectors to be more rigid in the inspection of railroad equipment; and that the commission intends henceforth to impose maximum instead of minimum penalties. This increase in vigilance is for the purpose, we are told, "to avert the usual spring crop of wrecks."

The Pennsylvania Railroad has increased the pay of 2,700 telegraphers, despatchers, agents and signalmen an average of 10 per cent. The employees were represented in negotiations by a committee of 28, headed by C. M. Giles. The readjustment will add $75,000 to the payroll of the company and will affect 790 offices and towers on the lines east of Pittsburgh. The question of a general increase for men of these classes throughout the system is now being considered. The question of granting two relief days a month will be taken up later.

The mayor of Youngstown, Ohio, has ordered the Erie railroad to cease running trains through the city faster than six miles an hour. This enforcement of an old city ordinance follows a long campaign in which the city has called on the Erie to abolish five grade crossings in the heart of the business section. The final crisis arrived on March 13, when an eastbound Erie passenger train crashed into a street car on one of the crossings, demolishing the car, seriously injuring 22 persons and killing two outright. The state railroad commission will investigate the case, and the city officers think the commission will order the road to abate the crossings. The cost of such a change would be very high, probably $1,000,000.

New Jersey Grade Crossing Law.

The law which has been passed in New Jersey to abolish grade crossings of highways and railroads is chapter 57 of the public laws of 1913. It gives the Board of Public Utility Commissioners authority to order railroads at their own expense to abolish a crossing whenever it shall appear that it is dangerous, or that public travel is impeded. The entire expense is to be borne by the railroad, except that (1) a street railway may be required to pay 10 per cent. of the direct cost; (2) the expense of relaying sewers, pipes, paving, etc., is to be borne by the city or town, and (3) wires, pipes, etc., belonging to corporations or private parties must be moved by their owners.

Passenger Train Equipped with Automatic Connectors.

A train on the Cincinnati, New Orleans & Texas Pacific, consisting of locomotive, mail, baggage and express car, combination coach, day coach and parlor car and operating between Cincinnati, Ohio, and Danville, Ky., has been equipped with automatic connectors for steam heat, brake and signal pipes, as well as a telephone line. According to officers of the railway the device has been in service two weeks with good results, the train covering 230 miles daily. The connector is manufactured by the Durbin Automatic Train Pipe Connector Company, St. Louis, Mo.

Speed Recorders on the Baltimore & Ohio.

The through passenger trains of the Baltimore & Ohio are now equipped with two speed recorders, two to a train; one in the baggage car and one in the locomotive. In the baggage car the "Haushalter" speed tape is used, while on the locomotives the Boyer speed recorder is used. Both of these machines make records on tapes. At the end of each trip the tape is taken out by the local inspector, who makes a suitable record of the date, time, etc., and sends the whole to the office of the general inspector of transportation, where a permanent record is kept. The information given on the tapes is checked against the rates of speed prescribed in the results limiting speed at different points on the road, so that excessive speed is at once brought to notice. The maximum speed of passenger trains on the Baltimore & Ohio, except between Philadelphia and Washington, is 60 miles an hour, and the officers require a rigid observance of the limit. On the Philadelphia-Washington line the limit is 65 miles an hour.

Railway Legislation, Passed and Proposed.

The Utah senate has rejected a bill providing for the creation of a public utilities commission.

The governor of Indiana has signed a bill passed by the legislature giving the railroad commission power to order the separation of grades at crossings in the state.

Both houses of the Missouri legislature have passed bills requiring all railways, electric railways, street railways and terminal companies to incorporate under the laws of Missouri. The senate bill prohibits such companies from transferring freight or passengers within the state, unless so incorporated, and imposes a penalty of $2,000 to $10,000 for each violation.

New York City Subways.

After exasperating delays in the courts and elsewhere extending over more than two years, the New York State Public Service Commission First district, on Wednesday of this week signed contracts with the Interborough Rapid Transit Company and the Brooklyn Rapid Transit Company for the construction and operation of new subways, designed to complete the system of underground rapid transit in the boroughs of Manhattan, Bronx, Brooklyn and Queens. The city government has appropriated $88,200,000 for this work, the estimated amount which will be necessary to pay for the share of the improvement which is to be paid for by the city.

Railroad Valuation and Rates.

It is not surprising that "members of the Interstate Commerce Commission are said to be staggered by the problem of physical valuation of railroads, telephone and telegraph lines, laid upon them by a recent act of Congress." It is said that "a huge corps of engineers and accountants and writers will be required for the valuation" and that "this is the most gigantic task ever imposed on any government." It may also be said that the task will cost an enormous sum and cannot possibly be accomplished with any approximation to accuracy. Such a result as may be reached will be absolutely worthless.

The man more responsible than any other for getting this

absurd requirement through Congress is Senator La Follette, of Wisconsin, and it is amazing that a majority of both parties should have been brought to its support. The only excuse for it is the contention that the Interstate Commerce Commission cannot determine what a reasonable rate is without knowing the actual value of the railroad property. This is the height of absurdity. It is certain that a reasonable rate cannot be determined by any such method as that proposed. The value of any property in use, that for which it can be bought or sold now and upon which its owners are entitled to a return, depends upon many considerations besides what it originally cost. A rule for rate-making, of the kind proposed, would throw into confusion the whole system of traffic and shift lines of communication all over the country, leaving many of them in ruins. If this task of the Interstate Commerce Commission should be prosecuted for a series of years at great cost to the government and the railroads, all paid for in the end by the people of the country, the result would be found to be utterly useless for the ostensible purpose. Congress ought to put a stop to the ridiculous farce.—*Journal of Commerce, New York.*

Argument for Government Valuation.

On the subject of valuation of railroads by the government, Chairman Clark of the Interstate Commerce Commission is quoted as follows:

The law requires that the rates of the carriers shall be reasonable. Manifestly the fair return upon the value of the property cannot be determined until the value of the property is known. In one important case involving advanced rates on a commodity that moves in large volume the carriers presented to the commission voluminous testimony as to the value of their properties. This testimony was uncontradicted, as no one aside from the carriers themselves had any reliable information on that subject. Advanced rates prescribed by the commission were established by the carriers, but the validity of the order was challenged in the courts. Exhaustive testimony was presented before the court in which the carriers again proved the value of their properties, and, strangely, those values for each of two carriers were something like $100,000,000 more than those which had been proved before the commission a comparatively short time before. And it was not because of additional investment or improvement in the interim. The commission was finally upheld by the Supreme Court of the United States. But suppose that the carriers had proved the value of their properties to have been much greater than they did. Who could have disproved the claim? Who knows the value of the property of a single carrier? Congress has provided a means for securing reliable authentic and exhaustive information on which to base a determination of the cost, the present, and the reproductive value of these properties that exist under public franchises and perform public functions. The owners of the properties are guaranteed a hearing upon any objections which they may desire to present against valuations proposed by the commission. The work is one of great magnitude, but the commission is not, as has been suggested, staggered or dazed by the duties that have been placed upon it. The work will be approached and proceeded with in a business-like, impartial and thorough way. The amount of available funds, the number of available, competent men, and the time necessarily spent in securing reliable information as to financial matters in the past, all bear directly on the question of how soon the work can be completed.

New Haven's Experience with the Automatic Stoppers.

The New York, New Haven & Hartford announces that since Mr. Mellen made his ten-thousand-dollar offer, published a few months ago, 1,574 automatic train stops have been presented to it; and that two of the devices submitted are going to be tried. The names of these two are not given, being withheld, evidently, for the purpose of breaking the news gently to the friends of the other 1,572. Proposals came from Panama, Porto Rico, Jamaica, Belgium, France, Ireland, Hawaiian Islands, England, Scotland, Wales, Germany, Denmark and a few other places. This list should make the government at Washington a trifle jealous, for in the list of applicants before the Block Signal Board, Panama, Porto Rico and Ireland do not appear. The New Haven people have searched the patent office records, and find there 1,483 patents on automatic stops and cab signals. The 91 devices not patented are, doubtless, so full of merit that they have no need of such adventitious protection as a patent.

Describing his experiences, an officer of the New Haven says: "Many of the devices submitted were ingenious, if not practical, but only about 5 per cent. of them were worthy of consideration. One device consisted of a heavy spring hook which it was claimed would automatically raise up from the roadbed when a train passed a signal and catch hold of an axle on one of the cars, thereby stopping the train. [Described in *Scientific American* about 30 years ago.] The competitors represent nearly every walk of life, from clergymen to jail birds. Four of them are in jail and one has recently been indicted in Canada for attempting to sell stock on false pretences [and has been sentenced to imprisonment in the United States]."

The New Haven road must henceforth be classed as a benevolent institution—anything but a soulless corporation. Merely to classify and acknowledge these 1,574 communications must have required a lot of work, and the statements of the officers indicate that they expect to test the two devices at the road's expense. Mr. Mellen's offer may be taken as one more demonstration of the power of money, for the number of inventions presented to him is more than double the number brought before the Block Signal Board at Washington during its four years' existence. A large share of the 1,146 schemes presented at Washington had to do with other elements of railroad operations; ties, rails, rail joints, brakes, life-saving cushions, health-promoting apparatus, etc.

Annual Report of Bureau of Explosives.

The annual report of Colonel B. W. Dunn, chief inspector of the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, shows that 14,609 inspections were made by the bureau during the last calendar year. The total number of packages condemned as unsafe for transportation was 5,197; 4,798 boxes of high explosives and 399 kegs of black powder. These figures show a decided reduction, the totals for the preceding year having been 6,591 boxes of high explosives and 1,205 crates of black powder. The number of cars in transit found to seriously violate the regulations was very much larger last year than the year before; 456 in 1912 and 210 in 1911.

The number of railway companies belonging to the bureau has steadily increased, and now aggregates 290; and the mileage of these lines is 249,751. The aggregate losses caused by accidents in transportation of explosives during the year 1912 was $10,200, which is very much less than in any preceding year of the record, except 1909, when the total was only $2,673. A table is given showing accidents occurring in the manufacture, storage or use of explosives, which during the year aggregated 56 accidents; persons killed 80; persons injured 93; property loss $2,136,428.

The inspectors of the bureau, reporting on cases of rough treatment of cars, have not been able to find any improvement over preceding years. Investigation of instances of rough handling of cars almost always brings from the operating officer of the railroad the reply that he finds no evidence of rough treatment. The train men do not attend the inspectors' lectures as often as do other employees. The inspectors have tried to instruct trainmen and yardmen by going into the yards at night; and they find that most of the men respond readily to instruction. Commenting on the difficulty of securing the interest of all employees in the instructions which are given by the inspectors, looking to safeguarding lives and property, Colonel Dunn says:

"The only cheap way to get valuable experience is to learn of the misfortunes of others. It is true unfortunately, that the maximum interest in our work is taken by those who have suffered from explosions. If a car of dynamite were to explode about once a year on the lines of each of our members, our lecture halls could not contain the audiences, and the reports of our inspectors would be on the top of every pile of correspondence awaiting action."

A general meeting of the bureau will be held in New York City in the month of May.

Thirty pages of the report are devoted to detailed accounts of accidents; eight pages to a report from the chemical laboratory, and twelve pages to lectures.

Full Crew Law: Cost $783,917.

President Samuel Rea, of the Pennsylvania Railroad, has sent to Governor William Sulzer of New York a protest against the proposed full crew law in that state, the bill for which has been passed by the Assembly and favorably reported to the Senate. Following a strong statement of arguments with which our readers are already familiar, Mr. Rea says:

"This measure lays down an arbitrary rule. There must be the same number of men on a passenger train, for example, whether it is a continuous run of 100 miles or a run involving stops at every way station. Such a rule adds an extra and unnecessary brakemen, arbitrarily, to a large number of trains. If he contributes to the safety of passengers or other train employees, by all means put him on the train. But no additional security is obtained. Advocates of similar legislation have been repeatedly and successfully challenged to name any serious accident resulting from insufficient train crews.

"Bills similar to that now pending in New York were vetoed by Governors Hughes and Dix, and also by Governor Foss of Massachusetts and Governor Harmon of Ohio, on the very proper ground that the public service commission should deal with all such questions. The decision in different cases should be left to the railroad manager, unless there is an inadequate or improper practice, in which case public service commissions should have power, after hearings, to prescribe the practice to be followed. As a matter of fact, there are runs on our own road calling for even more men than are stipulated in the unvarying rule of this bill. In other cases, a smaller number of men is quite sufficient.

"If then there is no additional safety and no increased efficiency in a superfluous crew, and if the public interests are adequately safeguarded through the Public Service Commission, why place upon the railroads, and ultimately upon the public, the burden of a heavy and fruitless expenditure?

"How will the unnecessary extra employees advantage the men already working for our company, especially our lines in New York state which do not now fully earn their fixed charges, let alone any dividends; or how will this unnecessary expense help these lines to provide the high character of service required by the public?

"Our records show that the Pennsylvania Railroad has already wasted $783,916.84 in complying with the extra crew law which is now being contested before the courts of Pennsylvania. How will a similar waste benefit the people of New York?"

In connection with Mr. Rea's letter the reader will be interested in the following extract from the *Wall Street Journal* of December 11, 1912:

"On November 3, two days before election, the legislative representative of the Brotherhood of Railroad Trainmen sent the following letter to all members of the organization in New York state: . . .

"Sirs and Brothers:

"Believing that the most important subject concerning our organization today is the full crew bill, and being anxious to secure the passage of said bill, I considered it my duty to learn the attitude of the candidate for governor who is most likely to win out, so I called upon the Hon. William Sulzer and requested that he state his position on this most important measure.

"Mr. Sulzer said to me, 'If I am elected I will sign the full crew bill, and I will aid you in securing its passage.' He also requested that I notify the lodges of the state as to his position. Continuing, he said: 'I would come out openly for the bill, but if I did the railroads would spend a barrel of money to defeat me. . . .'

"Fraternally yours,

"JOHN FITZGIBBONS, Leg. Rep. B. of R. T."

President W. C. Brown, of the New York Central, sent to the governor a letter similar to Mr. Rea's and adding certain other points. Mr. Brown said:

The placing of an additional man on all trains is not only not an additional source of safety but may prove otherwise. No accident in this State has ever been laid by a proper authority to undermanning of trains. Since the Public Service Commission has been in office it has not reported that a single one of the many accidents which have been investigated by it was caused by the undermanning of trains. It is estimated that if this legislation should become a law the increased cost to the railroads of the State would be $2,000,000 a year. The increased cost to the New York Central will be $750,000 a year. In the view of the railroad managers the expenditure of this vast amount of money will be a pure waste. It will in no sense tend to greater safety or greater efficiency of operation. It is a vast, unreasonable and unnecessary economic waste. The overmanning of a train causes the excess man or men to idle away their time, and thus detracts from the efficiency of the service performed.

If, however, there is any necessity for an increase of the number of men upon any trains, the Public Service Commission has jurisdiction to entertain a complaint and to make an authoritative decision. It has already exercised it in two cases, one being against the New York Central.

This particular bill and bills of a kindred nature are a direct and serious blow to the farmers of the State.

The State of New York consumes approximately $1,200,000,000 worth of farm products each year, but of this amount it produces only about $300,000,000 worth.

During the ten years from 1900 to 1910 the acreage of improved lands in the State of New York fell from 16,000,000 to 15,000,000, or a loss of 1,000,000 acres.

During the same period the production of butter fell from approximately 75,000,000 pounds in 1900 to 25,000,000 pounds in 1909.

The most discouraging obstacle in the way of agricultural improvement is the absolute inability to secure help. Dairy farmers are selling their cows, producers of cereals, vegetables and fruit are having their operations curtailed every year on account of the inability to obtain efficient help.

This bill, if it becomes a law, will draw from the present inadequate equipment of help on the farms of New York approximately 2,000 men, and will to that extent further cripple the farmers and discourage the efforts now being made in the interest of agricultural improvement in the State.

The railroad draws on the rural communities along its lines for nearly all its employees. There is no other source from which they can be recruited, and this bill, compelling the railroads to employ men for which there is not the slightest necessity, is an economic mistake and a direct blow at every farmer in the state now struggling desperately to keep help to run his dairy and maintain his farm.

American Society of Mechanical Engineers.

The railway committee of the American Society of Mechanical Engineers has arranged for the discussion of the subject of Steel Passenger Car Design in its various phases at a meeting to be held April 8, as mentioned in the *Railway Age Gazette* of March 7. The final list of papers and authors is as follows: Introduction to General Discussion of Steel Passenger Cars, H. H. Vaughan (C. P.); Interior Steel Finish, Felix Koch, Pressed Steel Car Company; Roof Structures, C. A. Seley (Rock Island Lines); Corrosion and Protection of Steel Passenger Cars, C. D. Young (Penna. R. R.); Problem of Steel Car Design, W. F. Kiesel, Jr. (Penna. R. R.); Suspension of Steel Cars, E. W. Summers, president, Summers Steel Car Company; Truck for Steel Passenger Cars, J. A. Pilcher (N. & W.); Provision for Electric Lighting in Steel Cars, H. A. Currie (N. Y. C. & H. R.); Provision for Electrical Equipment on Steel Motor Cars, F. W. Butt (N. Y. C. & H. R.); Special Ends for Steel Passenger Cars, H. M. Estabrook, president, Barney & Smith Car Company; Draft Gears for Steel Passenger Cars, S. P. Bush, Buckeye Steel Castings Company; Cast Steel Double Body Bolster and End Frames for Steel Cars, C. T. Westlake, Commonwealth Steel Company.

Railway Signal Association.

Secretary Rosenberg has announced that all of the propositions submitted to letter ballot at the last annual meeting have been adopted by the required two-thirds affirmative vote. The specifications, drawings, etc., thus adopted are printed in the March issue of the *Journal* of the association.

The proceedings of the association for the year 1912, including these newly adopted standards, will be issued about April 1, making volume 9. Bound in cloth, these proceedings will be sold to members of the association at $1.50, and to non-members at $2. Orders should be sent in to the secretary at once.

Secretary Rosenberg announces that Vandyke negatives or

blue prints of any one of the 124 standard drawings of the association will be furnished by him, full size, at the following prices: Vandyke negatives, 50 or over, 40 cents a copy; less than 50, 50 cents a copy: blue prints 18 cents each. The drawings are 8½ in. x 13 in.

American Society of Engineer Draftsmen.

The Boston members of the American Society of Engineer Draftsmen have made arrangements to hold a general gathering of draftsmen at Franklin Union, Boston, on March 25, with the idea of determining the advisability of forming a branch of the society. The New York office of the society has been moved from 116 Nassau street to 74 Cortlandt street, where larger space has been secured. Walter M. Smyth is secretary.

Machinery and Supply Convention.

A triple joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association and the American Supply & Machinery Dealers' Association will be held at Indianapolis, Ind., April 10-12. F. D. Mitchell, 309 Broadway, New York, is secretary of the American Supply & Machinery Dealers' Association.

American Society of Civil Engineers.

At the meeting of the American Society of Civil Engineers, March 19, a paper by E. J. Schneider, M. Am. Soc. C. E., entitled Construction Problems, Dumbarton Bridge, Central California Railway, was presented for discussion and illustrated with lantern slides. This paper was printed in the *Proceedings* for January, 1913.

New York Railroad Club.

The ninth annual electrical meeting of the New York Railroad Club will be held March 21. There will be no set papers, but addresses will be made by men actively engaged in the electrical field.

MEETINGS AND CONVENTIONS.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 6-9, St. Louis, Mo.

American Association of Demurrage Officers.—A. G. Thomason, Boston, Mass. Convention, May 20, Chicago.

American Association of General Passenger and Ticket Agents.—W. C. Hope, New York.

American Association of Freight Agents.—R. O. Wells, East St. Louis, Ill. Annual meeting, June 17-20, Buffalo, N. Y.

American Association of Railroad Superintendents.—E. H. Harman, St. Louis, Mo.; 3d Friday of March and September.

American Electric Railway Association.—H. C. Donecker, 29 W. 39th St., New York.

American Electric Railway Manufacturers' Assoc.—George Keegan, 165 Broadway, New York. Meetings with Am. Elec. Ry. Assoc.

American Railway Association.—W. F. Allen, 75 Church St., New York. Next meeting, May 21, New York.

American Railway Bridge and Building Association.—C. A. Lichty, C. & N. W., Chicago. Convention, October 21-23, 1913, Montreal.

American Railway Engineering Association.—E. H. Fritch, 900 S. Michigan Ave., Chicago. Convention, March 18-20, 1913, Chicago.

American Railway Master Mechanics' Association.—J. W. Taylor, Old Colony building, Chicago. Convention, June 11-13, Atlantic City, N. J.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.; annual, June, 1913.

American Society of Civil Engineers.—C. W. Hunt, 220 W. 57th St., New York; 1st and 3d Wed., except June and August, New York.

American Society of Engineering Contractors.—J. R. Wemlinger, 11 Broadway, New York; 2d Tuesday of each month, New York.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 39th St., New York.

American Wood Preservers' Association.—F. J. Angier, B. & O., Baltimore, Md. Next convention, January 20-22, 1914, New Orleans, La.

Association of American Railway Accounting Officers.—C. G. Phillips, 143 Dearborn St., Chicago. Annual meeting, May 28, Atlantic City, N. J.

Association of Railway Claim Agents.—J. R. McSherry, C. & E. I., Chicago. Next meeting, May, 1913, Baltimore, Md.

Association of Railway Electrical Engineers.—Jos. A. Andreucetti, C. & N. W. Ry., Chicago. Semi-annual meeting, June, 1913, Atlantic City, N. J.

Association of Railway Telegraph Superintendents.—P. W. Drew, 112 West Adams St., Chicago; annual, May 20, 1913, St. Louis, Mo.

Association of Transportation and Car Accounting Officers.—G. P. Conard, 75 Church St., New York.

Association of Water Line Accounting Officers.—W. R. Evans, Chamber of Commerce, Buffalo, N. Y. Annual meeting, October 8, Philadelphia, Pa.

Bridge and Building Supply Men's Association.—H. A. Neally, Joseph Dixon Crucible Co., Jersey City, N. J. Meeting with American Railway Bridge and Building Association.

Canadian Railway Club.—James Powell, Grand Trunk Ry., Montreal, Que.; 2d Tuesday in month, except June, July and Aug., Montreal.

Canadian Society of Civil Engineers.—Clement H. McLeod, 413 Dorchester St., Montreal, Que.; Thursday, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month, Chicago.

Central Railway Club.—H. D. Vought, 95 Liberty St., New York; 2d Thurs. in Jan. and 2d Fri. in March, May, Sept., Nov., Buffalo, N. Y.

Civil Engineers' Society of St. Paul.—L. S. Pomeroy, Old State Capitol building, St. Paul, Minn.; 2d Monday, except June, July, August and September, St. Paul.

Engineers' Society of Pennsylvania.—E. R. Dasher, Box 704, Harrisburg, Pa.; 1st Monday after 2d Saturday, Harrisburg, Pa.

Engineers' Society of Western Pennsylvania.—E. K. Hiles, Oliver building, Pittsburgh; 1st and 3d Tuesday, Pittsburgh, Pa.

Freight Claim Association.—Warren P. Taylor, Richmond, Va. Next convention, June 18, Bluff Point, N. Y.

General Superintendents' Association of Chicago.—E. S. Koller, 226 W. Adams St., Chicago; Wed. preceding 3d Thurs., Chicago.

International Railway Congress.—Executive Committee, 11, rue de Louvain, Brussels, Belgium. Convention, 1915, Berlin.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Annual meeting, May 21-24, Chicago.

International Railway General Foremen's Association.—Wm. Hall, 829 West Broadway, Winona, Minn. Next convention, July 22-25, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Annual meeting, August 18, Richmond, Va.

Maintenance of Way Master Painters' Association of the United States and Canada.—W. G. Wilson, Lehigh Valley, Easton, Pa.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 26-29, 1913, Chicago.

Master Car Builders' Association.—J. W. Taylor, Old Colony building, Chicago. Convention, June 16-18, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Annual meeting, September 9-12, Ottawa, Can.

National Railway Appliance Assoc.—Bruce V. Crandall, 537 So. Dearborn St., Chicago. Meetings with Am. Ry. Eng. Assoc.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass.; 2d Tuesday in month, except June, July, Aug. and Sept., Boston.

New York Railroad Club.—H. D. Vought, 95 Liberty St., New York; 3d Friday in month, except June, July and August, New York.

Northern Railroad Club.—C. L. Kennedy, C., M. & St. P., Duluth, Minn.; 4th Saturday, Duluth.

Peoria Association of Railroad Officers.—M. W. Rotchford, Union Station, Peoria, Ill.; 2d Thursday.

Railroad Club of Kansas City.—C. Manlove, 1008 Walnut St., Kansas City, Mo.; 3d Friday in month, Kansas City.

Railway Business Association.—Frank W. Noxom, 2 Rector St., New York. Annual dinner, second week in December, 1913, New York.

Railway Club of Pittsburgh.—J. B. Anderson, Penna. R. R., Pittsburgh, Pa.; 4th Friday in month, except June, July and August, Pittsburgh.

Railway Electrical Supply Manufacturers' Assoc.—J. Scribner, 1021 Monadnock Block, Chicago. Meetings with Assoc. Ry. Elec. Engrs.

Railway Gardening Association.—J. S. Butterfield, Lee's Summit, Mo. Next meeting, August 12-15, Nashville, Tenn.

Railway Development Association.—W. Nicholson, Kansas City, Southern, Kansas City, Mo.

Railway Signal Association.—C. C. Rosenberg, Bethlehem, Pa. Meetings, March 17, Chicago; June 10-11, New York; convention, October 14, Nashville, Tenn.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Annual convention, May 19-21, Chicago.

Railway Supply Manufacturers' Assoc.—J. D. Conway, 2135 Oliver bldg., Pittsburgh, Pa. Meetings with M. M. and M. C. B. Assocs.

Railway Tel. and Tel. Appliance Assoc.—W. E. Harkness, 284 Pearl St., New York. Meetings with Assoc. of Ry. Teleg. Sups.

Richmond Railroad Club.—F. O. Robinson, Richmond, Va.; 2d Monday except June, July and August.

Roadmasters' and Maintenance of Way Association.—L. C. Ryan, C. & N. W., Sterling, Ill. Convention, September 8-12, 1913, Chicago.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.; 2d Friday in month, except June, July and Aug., St. Louis.

Signal Appliance Association.—F. W. Edmonds, 3868 Park Ave., New York. Meetings with annual convention Railway Signal Association.

Society of Railway Financial Officers.—C. Nyquist, La Salle St. Station, Chicago.

Southern Association of Car Service Officers.—E. W. Sandwich, A. & W. P. Ry., Montgomery, Ala. Next meeting, April 17, Atlanta, Ga.

Southern & Southwestern Railway Club.—A. J. Merrill, Grant bldg., Atlanta, Ga.; 3d Thurs., Jan., March, May, July, Sept., Nov., Atlanta.

Toledo Transportation Club.—J. G. Macomber, Woolson Spice Co., Toledo, Ohio; 1st Saturday, Toledo.

Track Supply Association.—W. C. Kidd, Ramapo Iron Works, Hillsburn, N. Y. Meeting with Roadmasters' and Maintenance of Way Association.

Traffic Club of Chicago.—Guy S. McCabe, La Salle Hotel, Chicago; meetings monthly, Chicago.

Traffic Club of New York.—C. A. Swope, 290 Broadway, New York; last Tuesday in month, except June, July and August, New York.

Traffic Club of Pittsburgh.—D. L. Wells, Erie, Pittsburgh, Pa.; meetings monthly, Pittsburgh.

Traffic Club of St. Louis.—A. F. Versen, Mercantile Library building, St. Louis, Mo. Annual meeting in November. Noonday meetings October to May.

Train Despatchers' Association of America.—J. F. Mackie, 7042 Stewart Ave., Chicago. Annual meeting, June 17, Los Angeles, Cal.

Transportation Club of Buffalo.—J. M. Sells, Buffalo; first Saturday after first Wednesday.

Transportation Club of Detroit.—W. R. Hurley, L. S. & M. S., Detroit, Mich.; meetings monthly.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Annual meeting, August, 1913, Chicago.

Utah Society of Engineers.—R. B. Ketchum, University of Utah, Salt Lake City, Utah; 3d Friday of each month, except July and August.

Western Canada Railway Club.—W. H. Rosevear, P. O. Box 1707, Winnipeg, Man.; 2d Monday, except June, July and August, Winnipeg.

Western Railway Club.—J. W. Taylor, Old Colony building, Chicago; 3d Tuesday of each month, except June, July and August.

Western Society of Engineers.—J. H. Warder, 1735 Monadnock block, Chicago; 1st Monday in month, except July and August, Chicago.

Traffic News.

The Magnolia Petroleum Company is to construct a pipe line, eight inches in diameter, from Cushing, Okla., to Alvord, Tex., where it will connect with another line to the Gulf coast. The length of the new line will be about 210 miles and it will cost about $2,000,000. With the completion of this line, there will be four oil pipe lines connecting the Oklahoma fields with Texas.

Oliver Garby, of the Garby Produce Company, was arrested on March 13, at Los Angeles, Cal., on a complaint filed by an examiner of the Interstate Commerce Commission, charging him with having misrepresented the weight of a carload of vegetables shipped from Los Angeles to Goldfield, Nev., via the San Pedro, Los Angeles & Salt Lake. According to the complaint, Garby billed the carload at 25,000 lbs., and paid $255.63, while the correct weight was 31,500, for which the charge would be $322.09.

Traffic Club of New York.

At the regular meeting of the Traffic Club of New York, to be held March 25, Honorable John Barrett, director general of the Pan-American Union, will deliver an address on the Commercial Aspect of the Panama Canal.

INTERSTATE COMMERCE COMMISSION.

Long and Short Haul Rates on Southeastern Roads.

In a hearing at Washington this week, the Interstate Commerce Commission listened to arguments presented by railroads of the southeastern states objecting to the requirement of the commission that the long and short haul rule of the law be strictly complied with in that territory. Freight rates to all important points are determined by water competition, and also by a good deal of competition between markets of distribution, and the present adjustment of rates is necessary to the business prosperity of the region. Statements were presented showing estimates of losses which would be sustained if the commission's rule were to be adopted, the aggregate annual loss on shipments from the west being over $12,000,000, which is about 7 per cent. of the total gross freight revenue of the roads interested.

Weighing Cars; Hearings at Philadelphia and New York.

The Interstate Commerce Commission's investigation of weighing practices on the railroads of the country, which was the subject of hearings at Chicago last month, was continued in Philadelphia, March 10, and in New York, March 17.

The principal complainants at Philadelphia were retail coal dealers receiving anthracite coal over the Reading and the Pennsylvania roads. Numerous statements were made to the effect that cars falling short 2.5 per cent. were frequent, and that larger shortages were common. Robert H. Large, general coal freight agent of the Pennsylvania Railroad said that allowances of 1 to 2 per cent. were made for water when coal was shipped wet; but some of the individual coal operators refuse to declare their coal wet, and will not allow for the water loss to the receiver.

William H. White, president of the Pennsylvania Retail Coal Men's Association, suggested that the government should compel all shippers to notify the carrier when shipments are wet, and should require a uniform allowance for moisture. Mr. White said that weighing cars while in motion over the scales was not a sufficiently accurate method; and if a car gets by him, the weighmaster is liable to guess at its weight.

W. C. Dunning, a Philadelphia merchant, exhibited details of a claim which he had made against the Pennsylvania Railroad for shortages of coal amounting to $154,000. On this statement the average shortage was 2.5 per cent. James C. Tattersall, of Trenton, said that 20 per cent. of the cars of coal received by him weighed more than they were billed and 80 per cent. weighed less.

William C. Bister, chief of the police department of the Philadelphia & Reading, said that considerable coal was stolen from cars in yards; but the thieves are mostly women and children and convictions are hard to obtain.

At the hearing in New York, Arthur E. Rice, representing the New York Coal Dealers' Association, said that his clients had no complaints to make. They were getting all the coal they bought. Officers of the Erie and of the Central of New Jersey were questioned as to shortages of coal, coming from the anthracite regions over their lines, but they said that cars were carefully reweighed at tidewater, and that losses were not more than 1 per cent. Testimony was given by James Carr, scale inspector of the Delaware, Lackawanna & Western. W. J. Richards, general manager of the Philadelphia & Reading Coal & Iron Company, testified that coal was weighed on railroad scales, and explained in detail how the different kinds of coal are sorted at the mines.

Baggage Regulation.

In re regulations for fixing the dimensions of baggage. Opinion by Chairman Clark:

Prior to 1910 no restrictions existed as to the dimensions of baggage containers. The carriers were experiencing a difficulty, however, in handling the so-called "wardrobe" trunks and other trunks of freak shapes, which were of large, irregular and unwieldy dimensions, and which were used by traveling salesmen for the transportation of their samples. After a series of conferences, the western roads filed tariffs, effective July 1, 1912, which provided that where any dimensions of any piece of baggage exceeded 45 in. there would be an additional charge for each additional inch of each dimension exceeding 45 in. equal to the charge for 10 lbs. of excess baggage. This tariff also provided that on July 1, 1914, extra charges should be collected on the same scale on baggage any dimension of which exceeded 40 in.; also commencing July 1, 1912, no piece of baggage of any class the greatest dimension of which exceeded 70 in. would be transported in baggage cars. The rule adopted by the eastern lines contained substantially the same provisions, except that no declaration was made of intention at a future time to reduce the 45 in. limitation; also the charge for each additional inch above 45 in. is the same as for 5 lbs. of excess weight instead of 10 lbs. This rule does not apply to sample whips contained in flexible cases of leather or canvas, or to public entertainment paraphernalia. The tariffs containing these rules were suspended by the commission. The carriers maintained that it was necessary to preserve aisle space down the center of the car between the piles of baggage, and that this space should not be less than 23 in. wide. It was further shown that if this aisle space were 23 in. wide, only 40 in. would be left on either side of the aisle. This was why the western carriers proposed to make 40 in. the limit of dimension. The commission found that the question related not to the matter of revenue but primarily to the physical limitations of carrying facilities and to the conditions under which the baggage men must work; also that replacement of space is one of the essential factors in which carriers must necessarily give consideration in the furnishing of facilities required by law. Whips in flexible cases were exempted from the proposed limitation in the rule of the eastern lines, but because they exceeded 70 in. in length they were excluded by the western lines' rule from transportation as baggage in the future. Whip manufacturers proposed to pack their sample whips in single flexible canvas or leather cases not exceeding 12 in. in diameter at the base, which is the widest diameter, and not exceeding 90 in. in length or 100 lbs. in weight. As sample whips could not be carried in shorter cases, and as the weight of the cases was only 100 lbs., the carriers agreed to carry whips as baggage under the conditions stated free from other limitations as to dimensions. The commission consented to this exception. The commission found that the rule of the western lines was unreasonable, but decided that carriers could provide for an extra charge for the transportation of pieces of personal or sample baggage having dimension or dimensions exceeding 45 in., but that the extra charge per inch in excess of 45 in. should not exceed the charge for 5 lbs. of excess baggage. As there are now many trunks 72 in. long or over in service, and as it was shown that when placed on end they would not take up much more space than 70 in. trunks, the commission decided that the carriers could reasonably provide that a piece of baggage exceeding 72 in. in any dimension should not be accepted for checking as baggage. The commission found that trunks or rigid containers with more than two bulging sides, or with two bulging sides that are not opposite to each other, were inconvenient in tiering. A number of such

trunks are now in service, so with the idea of protecting the owners, the commission decided that, upon notice of not less than one year, carriers could provide that trunks or rigid containers of this character should not be accepted for checking as baggage. Carriers' definition of sample baggage should permit including salesmen's catalogs. At present the minimum overcharge for excess weight is 25 cents, and the commission decided that where the charges for excess weight and excess dimensions do not exceed this minimum charge, the single minimum charge of 25 cents shall apply. The commission ordered that new rules be adopted in accordance with these conclusions. (26 I. C. C., 292.)

STATE COMMISSIONS.

The New York State Public Service Commission, Second district, has called on the Erie to show cause for not complying with the law of New York, requiring that drinking cups be provided in cars for passengers. The road defends itself by calling attention to the federal law prohibiting the use of common drinking cups.

The New York State Public Service Commission, Second district, has rescinded its order made last November requiring the Boston & Albany to run a passenger train regularly from Chatham to Albany, 23 miles. The train has been run since November 24, and the average number of passengers has been only 11½ per day; and the commission decides it is not justified in directing the continuance of the operation of the train.

New Public Utilities Law in Indiana.

The legislature of Indiana has passed a law creating a Public Utilities Commission which will supersede the present state railroad commission. The law gives extensive power, like those of New York and Wisconsin. The number of commissioners will be five, or two more than the present railroad commission, but the intention seems to be that the present railroad commissioners shall hold over and be members of the new commission. The salaries of the commissioners and of the commission's counsel will be $6,000 a year each; secretary $3,600, and clerk $3,000. The commission is directed to value every public utility in the state.

COURT NEWS.

The government will appeal to the supreme court of the United States against the decision of the commerce court in granting an injunction which forbids the Interstate Commerce Commission to treat as common carriers certain pipe lines used only by their owners, for their own oil.

The federal court at Charleston, W. Va., has decided against the Norfolk & Western in the suit of the state to enforce a passenger tariff based on the uniform rate of two cents a mile. During the pendency of the suit the old rate of two and one-half cents has been collected, but with rebate checks, which will enable passengers to reclaim a half cent a mile, if the law is finally sustained.

The Supreme Court of Wisconsin has rendered a decision suspending a decision of the Dane county circuit court, and declaring constitutional the Wisconsin law of 1911, requiring railways running four trains each way daily, passing a given station, to stop at least two trains daily each way at that station. The Chicago, Burlington & Quincy had appealed from an order of the state railroad commission ordering the road to stop an additional train at Columbus, Buffalo county.

The Delaware, Lackawanna & Western has filed in the federal court at Trenton, N. J., its answer in the suit instituted against it by the government to compel a separation of the railroad company from the Lackawanna Coal Company. In general the charges made by the government are denied, the claim being made that the amount of traffic done, and the influence of the company as related to competitors, had been much overstated. The road denies that the coal purchased by it from independent mines has constituted almost the entire production of the mines; it is declared that the coal thus bought constitutes only a small part of the whole. The company denies that its financial ability or its power or its facilities have been used to the disadvantage of competitors.

In the case of the Southern and other railroad companies against the United States, the Commerce Court last week sustained the Interstate Commerce Commission. The railroad companies asked the Court to annul an order of the commission which had been made in 1912, requiring the carriers to refrain from collecting higher rates for carrying freight to and from Newport News than were collected from the southeastern territory to and from Norfolk. The Chamber of Commerce of Newport News contended that the carriers discriminated in favor of Norfolk and the commission held that the discrimination was unjust. The Commerce Court decides that it was for the commission to determine what the actual conditions surrounding the transportation were, and that it was for the commission to determine the method of service, the relative location of the two cities, how the interchange of freight is made, what the markets for traffic are, the extent of the competition, and other matters pertaining to the welfare of the communities affected. The court says that the commission was amply justified in finding as a fact that the City of Newport News was unjustly discriminated against by the carriers, and that the court would not disturb the finding of the commission.

Are All Pipe Lines Common Carriers?

The Commerce Court on March 12 granted a temporary injunction against the enforcement of the order of the Interstate Commerce Commission requiring certain private pipe lines to file tariffs.

The commission in this case accepted the law of Congress, passed in 1906, making such pipe lines common carriers. Being common carriers they become, when doing an interstate business, subject to the Interstate Commerce law. The Commerce Court, however, holds, evidence, that Congress in this legislation had exceeded its constitutional authority.

The lines involved in the present decision are the Prairie Oil & Gas Company, the Uncle Sam Oil Company, Robert D. Benson and others, the Ohio Oil Company, Standard Oil Company of New Jersey and the Standard Oil Company of Louisiana. In the summer of 1912 the commission, after an extended investigation, made an order requiring certain pipe lines to file tariffs showing their rates to the public for the transportation of oil. Six pipe line companies brought suits to enjoin the order of the commission and applied for preliminary injunctions. Some of these companies are Standard Oil companies, but others are independent companies in strong competition with the Standard.

It was claimed that the amendment in question applied only to such pipe lines, of which there are a considerable number, as are in fact common carriers, and hold themselves out to the public as such; and that if the amendment applied to all pipe line companies, whether public or private, and Congress thereby undertook to make common carriers of such pipe line companies as used their pipe lines solely for carrying their own oil in their own private business, the amendment was unconstitutional, because its necessary effect was to take private property without process of law and without compensation.

The commission held that the amendment of 1906 applied to all pipe line companies, but did not discuss its constitutionality, leaving the question to be decided by the courts. Judge Mack, while agreeing with the majority of the court as to the construction of the statute, dissented on the ground that Congress, in the exercise of its power to regulate interstate commerce, could regulate pipe line owners and pipe lines by prohibiting their use in interstate commerce until they permitted a like use to the public, on the payment of reasonable compensation; that the act did not involve an unlawful taking of property, and that even if the property could be held to be taken, the provision for reasonable compensation for its use met the constitutional requirement.

These six cases arose in as many different states; and the facility and expedition incident to their trial in the Commerce Court affords an illustration of the wisdom of Congress in establishing a single court for the hearing of interstate commerce cases. Under the old procedure these cases would have been tried in various circuits extending from New Jersey to Louisiana, necessitating six different trials and the additional expense in records and travel occasioned by each case being tried by itself rather than all being grouped in one court.

Railway Officers.

Executive, Financial and Legal Officers.

Henry B. Hull, assistant chief claim agent of the Illinois Central, has been appointed chief claim agent, with headquarters at Chicago, to succeed Charner T. Scaife, deceased.

W. P. Newton, assistant general auditor of the St. Louis & San Francisco, at St. Louis, Mo., has been appointed general auditor, with headquarters at St. Louis, succeeding T. B. Dixcy, resigned.

E. B. Pierce, auditor of the Ft. Worth & Rio Grande and the St. Louis, San Francisco & Texas, with office at Ft. Worth, Tex., has been appointed auditor of the Missouri, Kansas & Texas, with headquarters at St. Louis, Mo., to succeed T. O. Edwards, resigned.

J. W. Taylor, assistant comptroller of the Chicago, Milwaukee & St. Paul, has been appointed assistant to President Earling, with headquarters at Chicago, and the former position is abolished. B. A. Dousman, assistant auditor, has been appointed general auditor, with headquarters at Chicago.

J. B. Berry, who has been appointed assistant to the president of the Chicago, Rock Island & Pacific, has been chief engineer of the C. R. I. & P., since the year 1905, and during this time has for a considerable period been consulting engineer of the St. Louis & San Francisco. Before going to the Rock Island road, he was for some years chief engineer of the Union Pacific.

J. A. Jordan, vice-president of the St. Louis & Hannibal, the Green Bay & Western, the Ahnapee & Western, the Kewaunee, Green Bay & Western, and the Iola & Northern, with headquarters at Green Bay, Wis., has been elected president of all these roads, with headquarters at Green Bay, succeeding Stephen S. Palmer, deceased, and Edgar Palmer has been elected vice-president, with headquarters at New York, succeeding Mr. Jordan.

Operating Officers.

William Coughlin has been appointed general superintendent of the Missouri, Oklahoma & Gulf, with headquarters at Muskogee, Okla.

Charles Forrester, who has been appointed superintendent of the Stratford division of the Grand Trunk, with headquarters at Stratford, Ont., as has been announced in these columns, was born on March 5, 1876, at Wanstead and was educated in the public school of his native town and at the high school at Petrolea. He began railway work on July 15, 1891, with the Grand Trunk, and has been in the continuous service of that road ever since. He was an operator at various stations on that road until August, 1899, and was then made train despatcher at London. From August, 1906, to October of the following year, he was night chief despatcher, and in October, 1907, was promoted to chief despatcher. He remained in this position until July, 1910, when he was made trainmaster at Stratford, which position he held at the time of his appointment on January 22, as superintendent of the Stratford division of the same road with headquarters at Stratford.

C. Forrester.

Patrick K. Hanley has been appointed trainmaster of the Clinton, Havana and Decatur districts of the Illinois Central, with headquarters at Clinton, Ill., to succeed William Lamb, transferred.

C. E. Brower, trainmaster of the Atlanta, Birmingham & Atlantic, at Manchester, Ga., has been appointed superintendent of the Brunswick division, with headquarters at Fitzgerald, Ga., succeeding Adolph Moritz, resigned.

Owing to the death of A. W. Moss, superintendent of the Schuylkill division of the Pennsylvania Railroad at Reading, Pa., the duties of that position, until further notice, will be performed by G. W. Creighton, general superintendent of the Eastern Pennsylvania division, with headquarters at Altoona.

John C. Muir, whose resignation as division superintendent of the Chicago & Eastern Illinois, with office at Danville, Ill., was recently announced, has been appointed general superintendent of the Chicago, Terre Haute & Southeastern, with headquarters at Terre Haute, Ind., to succeed M. W. Wells, assigned to other duties.

J. F. Hickey, division superintendent of the Missouri, Kansas & Texas at McAlester, Okla., has been appointed superintendent of the Smithville district, with headquarters at Smithville, Tex., to succeed F. R. Blunt, resigned. It is reported that Mr. Blunt has accepted a position with a railroad in Brazil, South America.

Traffic Officers.

Joseph J. Brignall, traveling passenger agent of the Canadian Pacific at Toronto, Ont., has resigned.

J. C. Carey has been appointed commercial agent of the Toledo, St. Louis & Western, with headquarters at Memphis, Tenn.

H. C. Strohm has been appointed traveling passenger agent of the Baltimore & Ohio, with headquarters at Omaha, Neb., in place of Edward Emery, resigned.

Wm. Henderson has been appointed soliciting freight agent of the Georgia Southern & Florida, with office at Macon, Ga., succeeding W. B. Dewberry, assigned to other duties.

L. W. Mosher has been appointed commercial agent of the Missouri, Kansas & Texas at Oklahoma City, Okla., succeeding J. F. Reily, who has been transferred to Sedalia, Mo., as commercial agent in place of Mr. Mosher.

Walter Sorrell has been appointed assistant live stock agent of the Southern Railway, with headquarters at Greensboro, N. C., and C. D. Lowe has been appointed assistant live stock agent, with headquarters at Chattanooga, Tenn.

C. E. Horning, city passenger and ticket agent of the Grand Trunk, at Toronto, Ont., has been appointed district passenger agent, with office at Toronto, succeding A. E. Duff, resigned, and Charles E. Jenney, traveling passenger agent at Pittsburgh, Pa., succeeds Mr. Horning.

W. M. Campion has been appointed commercial agent of the Carolina, Clinchfield & Ohio, with headquarters at Cincinnati, Ohio, to succeed R. D. T. Hollowell, resigned to engage in other business. Frank P. McEwen, traveling freight agent, with office at Cincinnati, has been appointed commercial agent at that place, and the former position is abolished.

Engineering and Rolling Stock Officers.

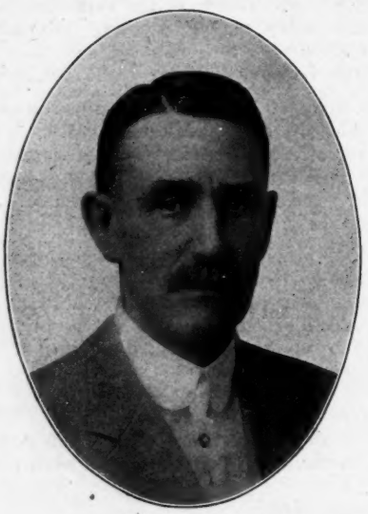
B. G. Horton has been appointed superintendent of locomotive fuel service on the New Orleans, Texas & Mexico, with headquarters at De Quincy, La.; Fred Hooker and O. Tefteller have been appointed superintendents of locomotive fuel service of the St. Louis, Brownsville & Mexico, both with headquarters at Kingsville, Texas.

S. W. Mullinix, mechanical superintendent of the second district of the Rock Island Lines at Topeka, Kan., has been appointed superintendent of shops at Silvis, Ill., succeeding G. W. Seidel, resigned. C. M. Taylor, mechanical superintendent of the third district at El Reno, Okla., succeeds Mr. Mullinix, and L. A. Richardson, master mechanic at Chicago, succeeds Mr. Taylor.

John D. Isaacs, formerly consulting engineer of the Harriman Lines at New York, has resigned from that office on the Union Pacific system, and remains as consulting engineer of the Southern Pacific Company. E. E. Adams, formerly assistant consulting engineer of the Harriman Lines at New York, succeeds Mr.

Isaacs as consulting engineer of the Union Pacific system, both with offices at New York.

Charles Adelbert Morse, chief engineer of the Atchison, Topeka & Santa Fe system, with headquarters at Topeka, Kan., has been appointed chief engineer of the Chicago, Rock Island & Pacific, with office at Chicago, succeeding J. B. Berry, who has been appointed assistant to the president. Mr. Morse was born on January 1, 1859, at Bangor, Me., and was educated at the University of Maine. He began railway work in 1880 as chainman, instrument and office man on the Chicago, Burlington & Quincy, remaining with that company until 1884. He was then division engineer of the Mexican Central, and for about a year and a half again in the service of the Burlington. From January, 1886, to July, 1901, he was with the Atchison, Topeka & Santa Fe as transitman, division engineer and resident engineer at Fort Madison, Ia., and at Pueblo, Colo.; and then until the following February was assistant chief engineer of the same road at Topeka. He was then principal assistant engineer at La Junta, Colo., until March, 1903, and the following five months was engineer of the Eastern Grand division at Topeka. In July, 1903, he was made acting chief engineer of the Atchison, Topeka & Santa Fe at Topeka, and one year later became assistant engineer. On September 1, 1905, he was appointed acting chief engineer of the company's Coast Lines, and in August, 1906, was made chief engineer of the Atchison, Topeka & Santa Fe proper, with headquarters at Topeka. He was later made chief engineer of the entire system, the position he now leaves to go to the Rock Island.



C. A. Morse.

OBITUARY.

Edward H. Eden, commercial agent of the Delaware, Lackawanna & Western, with headquarters at Minneapolis, died in that city on March 12, aged 43 years.

C. T. Scaife, chief claim agent of the Illinois Central, with headquarters at Chicago, died March 8, aged 65 years. He had been in the employ of the company continuously since December, 1872, and was appointed chief claim agent in June, 1910.

Reuben F. Smith, president of the Cleveland & Pittsburgh, with office in Cleveland, Ohio, died in the latter city March 11, aged 92 years. He had been connected with the Cleveland & Pittsburgh since 1855, when he was made paymaster. He became auditor six years later, and in 1869 was chosen vice-president. Later, under lease of the property to the Pennsylvania Railroad, he was appointed assistant general manager of the Cleveland & Pittsburgh division of the Pennsylvania Lines west of Pittsburgh. Subsequently he was elected president of the Cleveland & Pittsburgh Railroad.

Double Tracking in Spain.—The single-track railway from Barcelona to Villanueva y Geltru, province of Barcelona, is being double tracked. The line, which is 30 miles long, has already been double tracked 16 miles, from Barcelona to Castelldefels, and construction work has been commenced on the prolongation of the second track up to Villanueva y Geltfu. This work will necessitate construction of several tunnels through the Sierras de Garraf, to run parallel to the ones now in existence. The total cost of the work is estimated at about $1,080,000.

Equipment and Supplies.

LOCOMOTIVE BUILDING.

The Havana Central is in the market for 8 consolidation locomotives and 4 Pacific type locomotives.

The Union Railroad has ordered 5 consolidation locomotives from the Baldwin Locomotive Works.

The Pennsylvania Railroad has ordered 144 consolidation locomotives from the Baldwin Locomotive Works.

The American Smelting & Refining Company has ordered one six wheel switching locomotive from the Baldwin Locomotive Works.

The New York, New Haven & Hartford advises that it has just ordered 85 freight locomotives, 25 switching locomotives and 12 electric locomotives.

The Lakeside & Marblehead has ordered 1 six-wheel switching locomotive from the American Locomotive Company. The dimensions of the cylinders will be 21 in. x 28 in., and the total weight in working order will be 162,000 lbs.

The Keesville, Ausable Chasm & Lake Champlain has ordered 1 mogul locomotive from the American Locomotive Company. The dimensions of the cylinders will be 16 in. x 22 in., and the total weight in working order will be 96,000 lbs.

The Ohio & Kentucky has ordered 1 mogul locomotive from the American Locomotive Company. The dimensions of the cylinders will be 19 in. x 24 in., the diameter of the driving wheels will be 50 in., and the total weight in working order will be 112,000 lbs.

The Chesapeake & Ohio has ordered 12 Mallet (2-6-6-2) locomotives from the American Locomotive Company. These locomotives will be equipped with superheaters, will have 22 in. and 35 in. x 32 in. cylinders, 56 in. driving wheels, and in working order will weigh 425,000 lbs.

The St. Louis National Stock Yards have ordered 1 six-wheel switching locomotive from the American Locomotive Company. The dimensions of the cylinders will be 19 in. x 24 in., the diameter of the driving wheels will be 51 in., and the total weight in working order will be 121,000 lbs.

CAR BUILDING.

The Great Northern is making inquiries for 500 box cars.

The Grand Trunk is making inquiries for 3,000 forty-ton box cars and 1,000 fifty-ton coal cars. This road will soon order about 10,000 cars.

The New York, New Haven & Hartford advises that it has just ordered 50 coaches, 50 baggage cars, 25 postal cars and 11 dining cars, all of steel construction throughout.

The Havana Central, Cuba, mentioned in the *Railway Age Gazette* of February 14 as being in the market for 740 freight cars, is now in the market for 450 flat cars, 250 box cars, 50 coal cars and 12 passenger cars.

The Pennsylvania Lines West have ordered 42 coaches, 31 combination passenger baggage cars, 5 baggage cars, 5 dining cars and 2 mail cars. This order was divided between the American Car & Foundry Company, the Pressed Steel Car Company and the Standard Steel Car Company.

SIGNALING.

The Illinois Traction System will this season extend automatic block signaling so as to have the main line between Springfield and St. Louis entirely equipped. The new signaling will cover about 60 miles of road, the signals, style B, being furnished by the Union Switch & Signal Company.

The Buffalo, Rochester & Pittsburgh has contracted with the General Railway Signal Company, Rochester, N. Y., for automatic signal equipment for 85 miles of its road; 48 miles single track and 37 miles double track. The signals will be upper quadrant, three-position. The same road has bought telephone train despatching apparatus for 178 miles additional, and with this improvement will have the entire length of the road equipped with telephone despatching lines.

Supply Trade News.

Joseph K. Choate has been made a vice-president of the J. G. White Management Corporation, New York.

F. W. Hubbard, secretary of the Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, died on March 2.

Edgar N. Easton has associated himself with the railroad sales department of Joseph T. Ryerson & Son, with headquarters at New Haven, Conn.

George W. Greene has been appointed resident manager for Morgan T. Jones & Company, with headquarters at 213 Wabash building, Pittsburgh, Pa.

C. J. Morrison has resigned his position with Suffern & Son, and with others has organized Froggatt, Morrison & Company, 149 Broadway, New York, efficiency engineers.

Rex Gay, formerly with the Ajax Forge Company, Chicago, has resigned to accept a position with the Verona Tool Works, Pittsburgh, Pa., with headquarters in the Karpen building, Chicago.

John H. Craigie, formerly associated with the mechanical department of the Boston & Maine, is now associated with the railroad sales department of Joseph T. Ryerson & Son, with headquarters at Boston, Mass.

The Canton Culvert Company, Canton, Ohio, advises that J. H. Schlafly, president of the company, has been granted patent No. 1,055,806 on corrugated metal culverts of spiral construction and that in future it will protect its interests in this patent which it now controls.

The Asbestos Protected Metal Company, Beaver Falls, Pa., has acquired an additional tract of land adjoining its present main plant at Beaver Falls, upon which it is planning to build a special steel treating plant, a storage building, and a new single story steel and concrete factory for the manufacture of an architectural roofing tiles and asbestos shingles.

Judge Kohlsaat, of the United States Circuit Court at Chicago, on March 3, rendered a decision sustaining patents granted to George F. Colmer and George C. K. Colmer, now owned by the Standard Asphalt & Rubber Company, in the case of the Standard Asphalt & Rubber Company *vs.* the American Asphaltum & Rubber Company, for infringement, and issued an injunction restraining the latter company from further infringement of the patents.

The Pedrick Tool & Machine Company, 3640 N. Lawrence street, Philadelphia, Pa., has been formed by A. D. Pedrick and H. A. Pedrick, who have recently resigned from the firm of H. B. Underwood & Co. The new company will make and sell the Pedrick portable tools, including cylinder boring bars, cylinder and dome facers, crank pin turning machines, driving box planer tools, pipe benders, milling machines, radius planing attachments, and valve seat rotary planers. D. W. Pedrick has also resigned from H. B. Underwood & Co.

Among the bridges for which the Strauss Bascule Bridge Company has recently received orders are the following: A three-track bridge for the Boston Elevated over Mystic river, Boston, Mass.; a bridge for the Chicago, Burlington & Quincy across the Illinois river at La Salle, Ill.; a bridge for the Northern Pacific across Steilacoom creek, Wash.; a bridge for the Baltimore & Ohio across the East Chicago canal, near East Chicago, Ill.; a 160-ft. single-leaf bridge for the Department of Public Works, Canada, across the Cataraquia river at Kingston, Ont.; two bridges for the city of Green Bay, Wis., one across the East river and the other across the Fox river; a 202-ft. double-leaf bridge for the Sanitary District of Chicago over the south branch of the Chicago river at Jackson boulevard, Chicago; a highway bridge for Snohomish county, Wash., over Eby Slough; a 171-ft. double-leaf highway bridge across the Red river for the city of St. Boniface, Man. The bridges for the Northern Pacific and the Chicago, Burlington & Quincy are of the Strauss direct lift type, and are similar in design to the two bridges of this type already being constructed by the Grand Trunk Pacific and by Van Buren county, Ark. The Strauss direct lift type operates without flexible connections.

Railway Construction.

BILLINGS & EASTERN MONTANA.—An officer writes that the company is building a line with its own forces from Billings, Mont., northeast about 15 miles. The principal commodity to be carried on the line will be sugar beets. R. E. Shepherd, president; F. J. Egan, engineer, Billings. (See Billings & Central, March 14, p. 528.)

BUFFALO, ROCHESTER & PITTSBURGH.—An officer writes that contracts have been given to the Miller Construction Company, Lock Haven, Pa., for grading a three-mile branch at Craigsville, Pa., and a two-mile branch near Homer City.

CANADIAN PACIFIC.—According to press reports contracts for double-tracking 135 miles of the Lake Superior division, and 30 miles of the Ontario division, immediately west of Toronto, Ont., have been let as follows: Lake Superior division, Cartier sub-division, 29 miles, to Cook Construction Company, Sudbury; Chapleau sub-division, 13 miles, also on White River sub-division 33 miles, and Schrieber sub-division, 13 miles, to Dominion Construction Company, Toronto, Ont.; Schrieber sub-division, 22 miles, to Chambers, McQuaig, McCaffrey & Cochrane; Nipigon sub-division, 25 miles, to Dominion Construction Company. Ontario division—London subdivision, 30 miles, from Guelph Junction east to Islington, to Jones & Girouard, Ottawa. The contracts include the grading, bridge and culvert work, and track laying. (March 7, p. 459.)

A grading contract has been given to Janse Brothers, it is said, for work on 118 miles of the Bassano-Swift Current line from Bassano, Alta., east, and the work on 90 miles has been sub-let as follows: Ten miles out of Bassano, to Clifford & Company, Bassano; 30 miles to Frank Jackson, Calgary; 12 miles to David Fitzgerald, Carstairs; five miles to F. Brandenberg, Minneapolis; four miles to Cailawait Bros. & Batter, Brooks; seven miles to W. Pearson, Dillon, Mont.; and 22 miles to Noeherne & Mannix, Edmonton.

CHINOOK RAILWAY.—Application is being made to the Alberta legislature to incorporate this company to build from the Chinook Coal Company's mines at sec. 12, tp. 10, range 22, west 4th meridian, to the Crowsnest branch of the Canadian Pacific near Kipp, Alberta. Shepard & Dunlop, Lethbridge, Alberta, are solicitors for applicants.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—Extensive improvements are to be made in the McLean avenue yards in Cincinnati. Eight new tracks are to be constructed and the present tracks will be rearranged.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—The report of this company for the year ended December 31, 1912, shows that additional main tracks were laid from Miamisburg, Ohio, to Middletown; from Indianapolis, Ind., to Dix., and from Sharonville, Ohio, to Kyles; a number of sidings were also put in and a connection with the Erie constructed from Dayton to Cold Springs. Yard improvements were carried out at Beech Grove, Ind.; at Bellefontaine, Ohio, and at Harrisburg, Ill.

CLEVELAND SHORT LINE.—See Lake Shore & Michigan Southern.

DALLAS & CLEBURNE INTERURBAN.—This company, which is being promoted by E. P. Turner, Dallas, has not yet completed its organization. Mr. Turner owns franchises granted by the city of Dallas, also a right of way from Dallas southwest to Cleburne, and from Dallas north to Gainesville. Application has not yet been made for a charter, as it has not been definitely decided when the line will be built. It is expected that work will be started during 1913.

EDMONTON, DUNVEGAN & BRITISH COLUMBIA.—Contracts have been let for grading 170 miles, and work is now under way clearing the right of way. Track has been laid to Sunniebend, about 70 miles north of Edmonton, Alta., and this portion is to be ballasted at once. The plans call for building from Edmonton northwesterly via Dunvegan to Fort George, B. C. (November 15, p. 973.) J. D. McArthur & Co. are the general contractors.

GANANOQUE, PERTH & LANARK.—The Ontario legislature is being asked to incorporate this company, to build from Gananoque to Lanark, with a branch from Morton northerly to

Portland, and other branches. J. C. Judd, Ottawa, Ontario, is solicitor for applicants.

Lake Shore & Michigan Southern.—The report of this company for the year ended December 31, 1912, shows that on the Sandusky division additional main tracks have been provided, and considerable progress was made on the grade separation work, particularly in the Chicago territory, and in connection with the change of line at Port Clinton. The Cleveland Short Line was opened for operation in July, 1912, between Marcy, Ohio and Collinwood, 9.56 miles, and the entire belt line is now in operation around the city of Cleveland from Rockport on the west to Collinwood on the east, 19.64 miles. An agreement in conjunction with the New York Central & Hudson River has been made with the Lehigh Valley for a share of the land bought from the city of Buffalo, N. Y., known as the Hamburg strip, for enlargement of terminal facilities. The important improvements carried out during the year included additional main tracks from Elyria Junction, Ohio, to Amherst, and from Martin to Millbury; the separation of grades at Port Clinton and track elevation from Grand Crossing to Englewood. The freight yard at Ashtabula Harbor was enlarged and considerable dock improvements were carried out at that place. At Air Line Junction the yard improvements included additional tracks and subways. Between Toledo and Detroit double-tracking work and renewal of bridges was carried out, and at Buffalo a new draw-bridge was built over Buffalo creek. A locomotive and car repair shop was built at Elkhart, and at Englewood, the improvements included a new roundhouse, and power plant, also a car repair yard. A large amount of industrial and passing sidings, new signals, bridge and culvert renewals, additions and improvements to various station buildings and other structures were carried during the year.

Long Island.—The report of this company for the year ended December 31, 1912, shows that on the Bay Ridge improvement the tunnel section between Atlantic avenue and Central avenue, in Brooklyn, N. Y., and the filling in between streets and bridges of the section between Central avenue and Fresh Pond Junction was started in December, and this work will be carried on during 1913. Satisfactory progress has been made on the Jamaica improvement, and on the elimination of grade crossings through Richmond Hill. The platforms and station in the new location at Jamaica, will be put in operation in March, and the whole improvement will be finished during 1913. The North Side division improvement covers the elimination of grade crossings on the Fort Washington branch through Flushing, the laying of second track between Flushing and Great Neck, and the electrification of the lines to Port Washington and Whitestone Landing. This work calls for the elimination of 12 grade crossings. The line to Whitestone Landing was electrified and put in operation in August, and the line to Port Washington will be electrified by September, 1913. It is planned to let contracts and have work well under way in 1913, on the Woodside-Winfield cut-off. This improvement involves the elimination of 11 grade crossings. When this work is completed there will be no highway crossings at grade between New York City and Jamaica. A great deal was accomplished in beginning new work and completing work begun in the previous year on the elimination of grade crossings at 13 other points. The most important crossings are at the South Country Road, at Great River, at Oakdale, and Eastport and at Good Ground. The New York Public Service Commission has ordered the elimination of several crossings on the Montauk division at Bushwick Junction, and on the main line at Queens. Negotiations are now under way with the authorities of New York City in connection with crossings at Hollis on the main line. Work on these improvements will be pushed during 1913. The extension of main tracks during the year consisted of completing the second track on the Oyster Bay branch to Locust Valley; completion of third and fourth tracks to Lynbrook, and a small amount of work in connection with second track between Oakdale and Patchogue.

Louisville & Nashville.—See Tennessee Western.

Michigan Central.—The report of this company for the year ended December 31, 1912, shows that work was carried out on third and fourth main tracks from Junction Yards to Detroit, and on improvements at South Bound Yard, Detroit. Considerable work was carried out on the grade separations at Detroit and at Joliet, Ill.; also on additional yards at Windsor, Ont., at Graling, Mich., at Wenona and at River Rouge. Improvements were made to the yards, North Detroit and Belt Line Junction; double track was laid at Detroit, and miscellaneous siding, yard tracks and logging branches were constructed.

Missouri, Kansas & Texas.—An officer writes that surveys are now being made for an extension of the Wichita Falls & Southern south and west from New Castle, Tex. (March 14, p. 529.)

New York, New Haven & Hartford.—The Public Utilities Commission of Connecticut will give a hearing on March 26, to consider the application of this company in reference to the double tracking of the Berkshire branch, including all line changes incident to the double tracking, between Berkshire Junction, Conn., and New Milford, 13½ miles.

Norfolk & Western.—An officer writes that the company has completed arrangements for double-tracking work on 51 miles of the eastern section as follows: From the present end of the second track at Suffolk, Va., work on 15½ miles has been started, one-half of the work is being carried out by the company's forces, and the other half by the Luck Construction Company, Roanoke; from Disputanta, west eight miles, contract let to W. W. Boxley & Company, Roanoke; from Wilson, 16 miles to connect with a section of completed second track, one-half of this has been let to the Vaughan Construction Company, Roanoke, and the other half to Rinehart & Dennis Company, Charlottesville; from Elam west to Evergreen, 11½ miles, contract let to David W. Flickwir, Roanoke. A new double track structure is to be built to replace High Bridge over the Appomattox river. A contract for the masonry work has been given to W. W. Boxley & Company, Roanoke, and contract for the superstructure to the Virginia Bridge & Iron Company of the same place.

Orange Northeastern.—An officer writes that the plans call for building from Orange, Tex., in a general northeast direction via Vinton oilfield, La., and through Vinton, Starks, Fields, Merryville and Leesville to Natchitoches, about 135 miles. A branch is projected from Merryville northwest to Nacogdoches, Tex., about 90 miles. The company has absorbed the Nacogdoches Railway, a lumber road, and the Lutcher Moore lumber road running east from the Sabine river, 30 miles, will also form part of the system. This latter road is now being laid with heavy rails, and grading work is under way on a 6-mile extension to a connection with the Southern Pacific at Vinton. M. Tansey, Mount Pleasant, Tex., has the contract for the work. The company expects to develop a traffic in lumber, oil, cotton and grain. Edward Kennedy, president, Houston, Tex., A. B. Thurston, chief engineer, Orange. (February 7, p. 271.)

Oregon Short Line.—An officer is quoted as saying that an extension of the Twin Falls branch is to be built to a connection with the Central Pacific, probably at Wells, Nev.

Tennessee Western.—An officer writes that the plans call for building from Iron City, Tenn., northwesterly about 18 miles to a point in the center of Wayne county. No track has yet been laid. Contract for grading has been let to Lacy-McDowell & Company, Brentwood, Tenn. The grading work is about one-third completed, and it is expected that the line will be opened for business about September of this year. It will be operated by the Louisville & Nashville. The company expects to develop a traffic in forest products, iron ore, and agricultural products. C. N. Brady, president, Washington, Pa., W. W. Olney, chief engineer, Iron City, Tenn.

Wichita Falls & Southern.—See Missouri, Kansas & Texas.

RAILWAY STRUCTURES.

Aitkin, Minn.—The Northern Pacific has announced that it will build a new passenger station to cost approximately $30,000.

Beech Grove, Ind.—The report of the Cleveland, Cincinnati, Chicago & St. Louis for the year ended December 31, 1912, shows that repair shops were put up at Beech Grove, Ind., also that bridges were renewed at various points, and engine houses were built at Sharonville, Ohio, at Bellefontaine, at Carey, at Hillsboro, Ill., at Elkhart, Ind., and at Duane. At Harrisburg an engine house annex and coaling station, also a freight house were constructed, and a coaling plant was constructed and other im-

provements were made at Bellefontaine. New passenger station and water facilities were added at Carmi, Ill., and at various points other buildings were constructed during the year.

DALLAS, TEX.—Amended plans for the proposed Dallas station have been adopted, and it is announced that work will be started within four months, to be completed within a year or a year and a half after that time. The following officers of the Dallas Terminal Company, which will build the station, have been elected: President, F. G. Pettibone, of the Gulf, Colorado & Santa Fe; first vice-president, W. B. Scott, of the Southern Pacific; second vice-president, W. W. Webb, of the Missouri, Kansas & Texas; secretary, M. L. Buckner; treasurer, R. P. Roach.

DETROIT, MICH.—The report of the Michigan Central for the year ended December 31, 1912, shows that a large amount of money was spent for the increase and improvement of terminal facilities in and about Detroit, Mich. Work upon the extensive terminal station has progressed rapidly and it is expected that it will be completed and ready for use before January, 1914. The improvements to stations and other structures included a roundhouse, etc., at West Detroit; roundhouses and facilities at Bay City, North Yard, North Toledo, and at Wolverine, and a freight house and facilities at Lansing. A bridge was built at Fort street, Detroit, and some smaller structures were put up at various points.

HIGH BRIDGE, VA.—See Norfolk & Western under Railway Constructiion regarding construction of a new bridge over the Appomatox river.

HOUSTON, TEX.—The Texas & New Orleans has begun work on the construction of a new blacksmith and boiler shop building of re-inforced concrete construction, 314 ft. x 120 ft.

JAMAICA, N. Y.—The report of the Long Island for the year ended December 31, 1912, shows that in addition to the Jamaica improvements on which work is expected to be finished during 1913, the company has material for sub-stations, etc., on the ground for the line to Port Washington. It is expected that this work will be completed by September. At various points improvements were made to the passenger service facilities including new passenger stations at Bayshore, at Arverne, at Flushing Main street, at Murray Hill and at Hempstead, and work was started on new stations at Grand street, Newtown, and at Garden City. In addition high platforms in electrified territory, shelter sheds, passing sidings, platform extensions, etc., were built at 18 different points, and in connection with the freight service additional sidings, warehouse tracks, freight yards and additions to freight houses were built at 22 points. Improvements were also made to the company's shops, including the installation of new machinery, additions to buildings, etc.

MARQUETTE, MICH.—The Duluth South Shore & Atlantic is preparing to build a new 15-stall roundhouse.

SLATON, TEX.—The Gulf, Colorado & Santa Fe has appropriated $30,000 for the erection of a three-story passenger station and office building.

YOUNGSTOWN, OHIO.—The new freight house of the Baltimore & Ohio has been completed and it was put in use March 17. This structure, which, with surrounding improvements cost $500,000, is fireproof, and has a basement equipped for cold storage.

RAILWAY DEVELOPMENT NEEDED IN BRITISH EAST AFRICA.—For some time there has been a congestion of traffic on the Uganda Railway of British East Africa owing to a deficient supply of rolling stock. With the general development that is going on so rapidly in the country, the capacity of the cars and engines has been taxed far beyond their power to respond to the economic demands of an extensive and a variously productive region. The completion of some branch lines and the projection of others make the demand for railway equipment increasingly imperative. Considering the agricultural possibilities of this region, the extensive timber resources, the mineral prospects, the facilities for communicating with Europe and America, and the climate so conducive to European colonization, British East Africa must, for years to come, appeal to the railroad builder as a profitable field for the investment of capital.—*Consular Report.*

Railway Financial News.

ASHERTON & GULF.—This company has asked authority of the Railroad Commission of Texas to issue $550,000 bonds on 32 miles of its completed lines.

BOSTON & MAINE.—See New York, New Haven & Hartford.

CHICAGO & NORTH WESTERN.—The property of the Des Plains Valley, a subsidiary of the Chicago & North Western, has been merged with the parent company, the North Western having assumed the guarantee of the subsidiary's bonds.

DENVER, LARAMIE & NORTH WESTERN.—The Bankers Trust Company, New York, as trustee of the first mortgage bonds of 1910, of which about $1,500,000 have been issued, has brought suit in the United States district court at Denver to foreclose this mortgage and to have an additional receiver representing its interests appointed for the D. L. & N. W.

DES PLAINS VALLEY.—See Chicago & North Western.

NATIONAL RAILWAYS OF MEXICO.—E. N. Brown, president, in a recent interview in New York City, said in part in speaking of the effect of the revolution in Mexico: "Now as to the position of the National Railways of Mexico . . . grossly exaggerated statements have been published recently regarding our property losses. Since January 1 they have not exceeded $100,000. This amount includes the damage to or destruction of buildings, cars, locomotives and track. Our losses in earnings have not been so much from the destruction of property as from the necessity of using circuitous routes in order to keep traffic moving."

NEW YORK, NEW HAVEN & HARTFORD.—The Boston News Bureau intimates that as a result of the expected discontinuance of dividends on the Boston & Maine, directors of the N. Y. N. H. & H. will consider the question of reducing the New Haven dividend from 8 per cent. to 6 per cent.

PERE MARQUETTE.—The Guaranty Trust Company, New York, as trustee under the collateral indenture of March 1, 1911, is to offer for sale on March 20, $16,000,000 improvement and refunding mortgage 50-year 5 per cent. bonds. These bonds are held as collateral for $8,000,000 5-year 6 per cent. notes on which interst has been in default since September 1, 1912.

SOUTHERN NEW ENGLAND.—This subsidiary of the Grand Trunk, which was to have built a line from Palmer, Mass., to Providence, R. I., has been the subject of a special investigation by a committee of business men appointed by Governor Pothier, of Rhode Island, and this committee has decided not to recommend that the state lend its guarantee for $6,000,000 bonds.

UNION PACIFIC.—The California railroad commission, having failed to agree to any modification suggested of the plan for the dissolution of the Union and Southern Pacific, and the time for underwriting the sale of Southern Pacific stock held by the Union Pacific having expired on Saturday of last week, the plan has been abandoned, and it is understood that a new plan is being worked out by Southern Pacific and Union Pacific directors, and will in time be submitted to the new attorney general for his approval.

WESTERN MARYLAND.—The Western Maryland Terminal Company has applied to the Maryland Public Service Commission to issue $700,000 stock, and the Western Maryland has asked permission of the commission to buy this stock. The stock is to pay for land recently secured for terminals at Port Covington.

RAILROAD CONSTRUCTION SYNDICATE.—Negotiations are being conducted between a group of French capitalists headed by the Russo-French Commercial Bank and the representatives of a number of Russian banks in regard to the organization of a syndicate for railway construction. According to their plan, they will finance railway companies that are already organized, purchase concessions, make investigations, etc. Special attention is to be paid to the east and south of Siberia, the Caucasus, and Turkestan. One of the participators of this syndicate is already taking part in construction of railways.

ANNUAL REPORTS.

FORTY-THIRD ANNUAL REPORT OF THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY.

To the Stockholders of

THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY:

The Board of Directors herewith submits its report for the year ended December 31, 1912, with statements showing results for the year and the financial condition of the company.

The mileage embraced in the operation of the road is as follows:

	Miles
Main line and branches	871.00
Proprietary lines	289.32
Leased lines	521.90
Trackage rights	190.08
Total road operated	1,872.30

An increase of 97.23 miles in road operated is due to the acquisition through lease of the Lake Erie, Alliance and Wheeling Railroad and to the opening for operation of 9.56 additional miles of the Cleveland Short Line Railroad extending from Marcy, Ohio, to Collinwood, Ohio. There is a reduction of .36 miles due to remeasurement and adjustment of mileage of the Lake Erie and Pittsburg Railway. The net total increase in miles operated over 1911 is 96.87 miles. A statement showing in detail the miles of road and track operated will be found upon another page.

There was no change in capital stock during the year, the amount authorized and outstanding December 31, 1912, being $50,000,000.00.

The mortgage, bonded and secured debt outstanding on December 31, 1911, was		$168,172,482.57
It has been increased during the year by pro-rata liability for certificates under the New York Central Lines Equipment Trust agreement of 1912		2,974,961.25
		$171,147,443.82
It has been decreased during the year as follows:		
January 1, pro-rata of second installment 1910 equipment trust	$918,071.04	
November 1, pro-rata of fifth installment 1907 equipment trust	447,226.18	
By reduction of liability for certificates outstanding under 1910 trust, account transfer of 25 locomotives to Michigan Central Railroad Company	375,979.50	1,741,276.72
Total mortgage, bonded and secured debt outstanding December 31, 1912		$169,406,167.10

SUMMARY OF FINANCIAL OPERATIONS AFFECTING INCOME.

OPERATING INCOME.	1912.	1911.	Increase or Decrease.
RAIL OPERATIONS—	1,872.30 miles operated	1,775.43 miles operated	96.87 *miles*
Revenues	$54,283,616.52	$48,360,997.13	$5,922,619.39
Expenses	35,534,644.36	32,443,875.09†	3,090,769.27
NET REVENUE — RAIL OPERATIONS	$18,748,972.16	$15,917,122.04	$2,831,850.12
Percentage of expenses to revenues	(65.46%)	(67.09%)	—(1.63%)
AUXILIARY OPERATIONS—			
Revenues	$1,206,895.79	$577,657.87	$629,237.92
Expenses	1,091,491.27	608,734.97	482,756.30
NET REVENUE—AUXILIARY OPERATIONS	$115,404.52	*$31,077.10	$146,481.62
NET OPERATING REVENUE	$18,864,376.68	$15,886,044.94	$2,978,331.74
RAILWAY TAX ACCRUALS	1,771,097.88	1,673,939.54	97,158.34
OPERATING INCOME	$17,093,278.80	$14,212,105.40	$2,881,173.40
OTHER INCOME.			
From lease of road	$5,000.00	$5,000.00	
Hire of equipment—credit balance	551,998.49	157,555.78	$394,442.71
Joint facility rents	357,851.47	336,426.83	21,424.64
Miscellaneous rents	98,394.37	132,904.57	—34,510.20
Net profit from miscellaneous physical property	1,211.26	.....	1,211.26
Separately operated properties—profit	1,272,125.22	557,040.96	715,084.26
Dividend income	6,904,180.66	7,878,679.77	—974,499.11
Income from funded securities	488,311.25	288,623.75	199,687.50
Income from unfunded securities and accounts	663,001.23	845,556.19	—182,554.96
Miscellaneous income	6,702.73	82,800.43	—76,097.70
TOTAL OTHER INCOME	$10,348,776.68	$10,284,588.28	$64,188.40
GROSS INCOME	$27,442,055.48	$24,496,693.68	$2,945,361.80
DEDUCTIONS FROM GROSS INCOME.			
For lease of other roads	$2,663,239.19	$2,531,081.50	$132,157.69
Joint facility rents	774,143.47	449,678.61	324,464.86
Miscellaneous rents	8,029.45	5,173.90	2,855.55
Miscellaneous tax accruals	5,948.22	.....	5,948.22
Separately operated properties—loss	178,693.51	109,624.81	69,068.70
Interest for funded debt	6,678,440.31	6,567,806.05	110,634.26
Interest for unfunded debt	549,177.27	563,963.49	—14,786.22
TOTAL DEDUCTIONS FROM GROSS INCOME	$10,857,671.42	$10,227,328.36†	$630,343.06
NET INCOME	$16,584,384.06	$14,269,365.32	$2,315,018.74
DIVIDEND APPROPRIATIONS OF INCOME—			
On guaranteed stock (18%)	$96,030.00	$96,030.00	.....
On common stock (18%)	8,903,970.00	8,903,970.00	.....
TOTAL DIVIDEND APPROPRIATIONS OF INCOME	$9,000,000.00	$9,000,000.00	.....
INCOME BALANCE TRANSFERRED TO CREDIT OF PROFIT AND LOSS	$7,584,384.06	$5,269,365.32	$2,315,018.74

*Deficit.
†Revised for purposes of comparison.

Amount to credit of profit and loss (free surplus), December 31, 1911		$36,154,623.35
Balance to credit of profit and loss for the year 1912		7,584,384.06
		$43,739,007.41
Deduct:		
Initial payment of ten per cent on New York Central Lines equipment trust of 1912	$330,551.25	
New equipment purchased from the company's proportion of profit from operations of the Pittsburgh McKeesport and Youghiogheny Railroad.	777,311.07	
Expenditures for additions and betterments, equipment, etc., on account The Lake Erie Alliance and Wheeling Railroad Company	582,594.75	
Value of property at Ashtabula Harbor and other locations abandoned during the year	408,939.39	
Commissions and expenses on sterling and franc notes	80,108.44	
Commission and expenses (net) on New York Central Lines equipment trust certificates of 1912	48,545.87	
For adjustment of sundry accounts including uncollectible items	323,788.75	2,551,839.52
Balance to credit of profit and loss (free surplus), December 31, 1912		$41,187,167.89

The revenues from rail operations for the year were the largest in the history of the road, amounting to $54,283,616.52, an increase of $5,922,619.39, or 12.25% as compared with the previous year.

Freight revenue was $36,371,244.49, an increase of $5,269,909.87. The revenue freight carried amounted to 41,081,573 tons, or 6,193,876 tons more than last year. With the exception of products of animals, each group of commodities shows a greater tonnage carried than in 1911. The notable increases are, anthracite and bituminous coal 2,218,874 tons; ores 916,501 tons; stone, sand and other like articles 890,269 tons; other castings and machinery 296,208 tons; bar and sheet metal 263,226 tons, and other manufactures 490,393 tons. There was a slight decrease in the average rate per ton mile due to reduction in lake coal rates effective May 1, 1912.

Passenger revenue amounted to $11,835,198.83, an increase of $485,103.16 over last year, attributable to additional business. There was an increase in local passengers carried of 144,232, a decrease in interline passengers carried of 92,932, resulting in a net increase of 51,300 passengers.

Revenue from transportation of mails was $1,974,227.76, a decrease of $204,405.87, being the result of a reweighing of mails commencing September 1, 1911, when the United States Post Office Department inaugurated the transportation of magazines and periodicals by freight service at freight tariff rates, since which time the earnings from that class of matter have accrued to freight revenue.

Revenue from express traffic was $1,985,690.32, an increase of $239,754.48, attributable to the additional business handled during the year.

Other transportation revenues amounted to $1,626,784.00, an increase of $143,197.60, principally due to larger revenue derived from switching service.

Revenues other than from transportation were $490,471.12, a decrease of $10,939.85. The principal decrease is in rents of buildings and other properties, due to cancellation of leases of the company's coal and ore unloading machinery at Ashtabula Harbor, which have been taken over for direct operation by the company.

Operating expenses for the year, by groups, were:

		Increase.	Per Cent
Maintenance of way and structures	$6,516,211.90	$337,588.59	5.46
Maintenance of equipment	9,283,832.83	1,214,439.89	15.05
Traffic expenses	961,761.66	*64,555.63	6.29
Transportation expenses	17,797,334.45	1,552,282.23	9.55
General expenses	975,503.52	51,014.19	5.52
Total	$35,534,644.36	$3,090,769.27	9.53

*Decrease.

The increase in maintenance of way and structures was occasioned largely by the very heavy volume of traffic moved over the road during the year. To maintain the roadbed and track in first class condition, additional track men were employed and owing to the scarcity of laborers of that class, it was necessary, in order to secure and hold a sufficient force, to grant a higher scale of pay, which in itself added $95,000. to roadway and track expense. Severe weather conditions during the first three months of the year caused a large expense for removal of snow, sand and ice. Several large bridges were renewed during the year. There were increased payments for the use of other companies' tracks under trackage right agreements. The expense for maintenance of signals and interlockers was not so large as in 1911, owing to unusually heavy expenditures in that year for renewal of various interlocking plants.

The great demand on the company's equipment to transport the large volume of traffic moved during the year, made necessary increased charges to maintenance of equipment expenses. In order to keep equipment in service and up to standard, 199 more locomotives received general repairs than in the previous year and 85,615 more freight cars were repaired than in 1911. Additional charges to renewal of equipment were occasioned by a larger number of old and obsolete locomotives and freight cars having been disposed of and dismantled during the year.

Traffic expenses indicate a decrease as compared with the previous year. Participation of the company in the expenses of fast freight lines was considerably diminished, owing to some withdrawals and reductions in assessments.

In transportation expenses practically all items affected by the volume of traffic handled, show increases. This is clearly attributable to the fact that the company transported 6,193,876 more tons of freight than in 1911. Although increased expenses are shown, there was a considerable saving in the cost of road service, particularly in consumption of fuel. Tonnage

moved during the year increased 17.75 per cent. over the previous year, while freight train miles increased only 7.81 per cent. and freight locomotive miles 6.7 per cent. Demand made upon the company by enginemen for increased scale of wages was submitted to arbitration, resulting in an award granted to this class of labor, which added to the cost of transportation expenses subsequent to May 1, 1912. Expenses growing out of personal injury claims were large, there having been serious crossing accidents at 105th Street, Cleveland, and Ashtabula, Ohio. Furthermore, the personal injury compensation laws passed in various States through which the company operates, has materially affected this item of expense.

General expenses show an increase of $51,014.19. Of this increase $15,408.88, represents additional disbursements to retired employes for pensions.

Net revenue from auxiliary operations for the year increased $146,481.62, through the taking over for direct operations by the company, of the unloading machinery on its docks at Ashtabula Harbor, Ohio.

Railway tax accruals amounted to $1,771,097.88, an increase of $97,158.34 over the previous year, and is attributable to higher valuations placed upon the company's property by various State Tax Commissions.

Other income for the year amounted to $10,348,776.68, an increase of $64,188.40 as compared with the previous year. Additional income was derived from hire of equipment and separately operated properties due to a greater excess of the company's equipment having been in use on foreign lines and to the larger surplus for the year of the Pittsburgh McKeesport and Youghiogheny Railroad in which the company has a one-half interest. The increase shown in income from funded securities is accounted for by the full year's interest received on bonds of The Cleveland Short Line Railway Company and The Lake Erie and Pittsburg Railway Company, acquired by The Lake Shore and Michigan Southern Railway Company last year in reimbursement of notes of those companies. The retirement of the notes mentioned caused a decrease in the unfunded securities which practically offset the increase in income from funded securities. Income from dividends on stocks owned by the company decreased $974,499.11, due to reduction of extra dividends by The Pittsburgh and Lake Erie Railroad and The Mahoning Coal Railroad Companies.

Deductions from gross income for the year were $10,857,671.42, an increase of $630,343.06, due to following causes:

Deductions for lease of other roads increased $132,157.69, due to a full year's rental paid to The Cleveland Short Line Railway Company as compared with nine months last year, and to rental paid through lease of The Lake Erie Alliance and Wheeling Railroad, effective July 1, 1912.

Joint facility rents increased $324,464.86, principally due to payments covering the entire year for trackage rights acquired over the Pennsylvania and Baltimore and Ohio Railroads in connection with operation of the Lake Erie and Pittsburg Railway.

Separately operated properties—loss, increased $69,068.70, owing to participation by the company in the guarantee in connection with the Merchants Despatch Transportation Company.

Interest for funded debt increased $110,634.26, due to a full year's interest having been accrued on $5,720,000.00 of gold bonds of 1906 issued in 1911, as against a partial year's accrual for that year, and also to interest accrued on the company's pro-rata of equipment trust certificates of 1912, there being no corresponding charge in 1911.

From the net income of the company for the year, amounting to $16,584,384.06, there were paid three dividends on both the guaranteed and common capital stock, aggregating 18 per cent or $9,000,000.00 leaving a balance of $7,584,384.06, which was transferred to the credit of profit and loss.

There was expended during the year for additions and improvements to the property $3,238,615.21, all of which was charged direct to capital account. For the increased train movement on the Sandusky Division, additional main tracks have been provided. To facilitate the movement of traffic and to meet municipal requirements, it has been necessary and desirable to extend the work of grade separation, upon which substantial progress has been made during the year, particularly in the Chicago territory and in connection with the change of line at Port Clinton. The company has also provided additional yard, station, enginehouse and shop facilities to meet the requirements of the increase in business. Details of such expenditures will be found on a following page.

The company as owner of the entire outstanding capital stock of The Lake Erie Alliance and Wheeling Railroad Company, entered into an agreement and lease effective July 1, 1912, whereby it acquired the right to use for the term of its corporate existence, the railroad and properties of The Lake Erie Alliance and Wheeling Railroad Company, extending from Phalanx, Ohio to Dillonvale, Ohio, a distance of 87.67 miles. The Lake Shore and Michigan Southern Railway Company will keep and maintain at its own expense the railroad and properties leased, and is to receive all revenues derived from the operation thereof. As rental it agrees to pay an amount equivalent to four per cent per annum on the outstanding capital stock, interest on the outstanding obligations, and all taxes and assessments of that company.

The opening for operation on July 1, 1912, of that part of the Cleveland Short Line Railway between Marcy, Ohio, and Collinwood, Ohio, a distance of 9.56 miles, has placed in operation the entire belt line around the city of Cleveland, Ohio, extending from Rockport on the west, to Collinwood on the east, a distance of 19.64 miles.

The company issued on March 2, 1912, notes payable February 24, 1913, for 25,000,000 francs equivalent to $4,827,898.55 and sterling notes payable March 2, 1913, for 1,400,000 pounds or $6,819,889.50, making a total of $11,647,788.05, from the proceeds of which the company retired its one year franc notes that matured March 4, 1912, amounting to 60,000,000 francs.

The company purchased from The Michigan Central Railroad Company 30,000 shares of the common stock, par value $3,000,000.00 of the Chicago Indiana and Southern Railroad Company, and also demand promissory notes issued by the latter company, amounting to $495,000.00. Through the acquisition of this stock the company became possessed of all of the outstanding capital stock of the Chicago Indiana and Southern Railroad Company. In the consummation of this transaction it was stipulated that The Michigan Central Railroad Company would be released from its obligation under a contract dated January 15, 1908, by which that company agreed to hold The Lake Shore and Michigan Southern Railway Company harmless from liability on its guaranty of $3,825,000.00 of the fifty year gold mortgage bonds of the Chicago Indiana and Southern Railroad Company.

There were also acquired during the year by purchase, 27,998 shares of stock, par value $1,399,900.00 of The Pittsburgh McKeesport and Youghiogheny Railroad Company. 47.881 shares of stock, par value $2,394,050.00 of The Pittsburgh and Lake Erie Railroad Company, 25 shares of stock, par value $2,500.00 of the Kanawha and Michigan Railroad Company, $1,000,000.00 of The Cleveland Cincinnati Chicago and St Louis Railway Company general mortgage four per cent bonds and $97,000.00 of The Toledo and Ohio Central Railway Company, St. Mary's Division, first preference income bonds.

The Board has authorized the cancellation of the agreement dated November 1, 1907, between the Merchants Despatch Transportation Company, The New York Central and Hudson River Railroad Company, The Lake Shore and Michigan Southern Railway Company, The Michigan Central Railroad Company, The Cleveland Cincinnati Chicago and St Louis Railway Company, The Pittsburgh and Lake Erie Railroad Company, The Peoria and Eastern Railway Company, Rutland Railroad Company, The Lake Erie and Western Railroad Company and the Chicago Indiana and Southern Railroad Company, covering the use of Merchants Despatch Transportation Company refrigerator cars by those companies, to be effective January 1, 1913, and has further authorized the purchase, in conjunction with The New York Central and Hudson River Railroad Company, at its present value, of the Merchants Despatch Transportation Company's refrigerator equipment, consisting of 5,388 owned cars and 1,000 leased cars covered by Merchants Despatch Transportation Company Equipment Trust of 1911. Apportionment between the purchasers is to be on the basis of their respective stock ownership in the Merchants Despatch Transportation Company. Through this division of the equipment, The Lake Shore and Michigan Southern Railway Company will acquire 2,520 of the owned cars and an equity in 468 of the equipment trust cars. The Board has also on behalf of the company, given consent to a reduction of the capital stock of the Merchants Despatch Transportation Company from $5,000,000.00 to $1,200,000.00, under which authority this company will sell, at par, 17,772 shares of its present holding in that company.

All agreements with various dock companies for the lease of ore docks owned by the company at Ashtabula Harbor, and for the handling of ore at that point were terminated as of May 1, 1912, and new agreements were made providing for the handling of ore from vessels to cars by the company through the agency of contractors. In this connection, the company purchased the machinery owned by the Pittsburgh and Conneaut Dock Company located on the company's property at Ashtabula Harbor, agreeing to pay therefor the sum of $775,672.61 in five equal installments.

During the year the company acquired under contract about 76,000 acres of coal lands in Christian, Montgomery, Fayette, Saline, Franklin and Williamson Counties, Illinois, at a cost of approximately $2,500,000.00. Deeds for 16,300 acres have already been delivered and $728,309.98 paid by this company therefor. These coal lands are on or near the line of The Cleveland Cincinnati Chicago and St Louis Railway Company, the majority of whose stock is owned by this company, and the said lands are tributary to the Cleveland Cincinnati Chicago and St Louis Railway and the Chicago Indiana and Southern Railroad, which latter is subsidiary of this company. Contracts have been entered into by The Cleveland Cincinnati Chicago and St Louis Railway Company for the purchase of these lands from this company at cost, plus 5% interest, payable July 1, 1917, and it has made an initial payment of $150,000.00 on account thereof. The Guaranty Trust Company of New York has acted as agent for The Lake Shore and Michigan Southern Railway Company in the making of these purchases and contracts.

Under an agreement dated February 1, 1912, the company has granted to The Bessemer and Lake Erie Railroad Company the right to use the tracks of The Lake Shore and Michigan Southern Railway Company between Dock Junction and Wesleyville, Pennsylvania. The company has also, as lessee of the Jamestown Franklin and Clearfield Railroad Company, granted to The Pennsylvania Southern Railroad Company, under an agreement dated December 30, 1912, the right to run over the tracks of the Jamestown Franklin and Clearfield Railroad Company between Sutton and Franklin, Pennsylvania, one passenger train each way per day.

Under date of August 22, 1912, this company in conjunction with The New York Central and Hudson River Railroad Company, entered into an agreement with the Lehigh Valley Railroad Company for a share in its purchase from the City of Buffalo of a tract of land known as the "Hamburg Canal Strip," for enlargement of terminal facilities, at a cost of $500,000.00, of which The Lake Shore and Michigan Southern Railway Company's proportion will approximate $150,000.00.

In the operation of the Pension Department 61 employes were retired and placed upon the pension rolls. Of these retirements, 34 were authorized because of the attainment of seventy years of age and 27 because of total and permanent physical disability. Twenty-four pensioners died during 1912 and at the close of the year 346 retired employes were carried upon the pension rolls. The average monthly pension allowance to these men was $23.33 and the total amount paid in pension allowances during the year was $99,528.28.

By an arrangement made with the Guaranty Trust Company, Trustee of the New York Central Lines Equipment Trust of 1910, the company assigned and delivered during the year to The Michigan Central Railroad Company twenty-five class G-6 locomotives acquired by the company under the terms of that trust, The Michigan Central Railroad Company assuming payment of the remaining unpaid installments applicable to the locomotives so assigned.

On November 20, 1912, the Board of Directors authorized The Lake Shore and Michigan Southern Railway Company, together with The New York Central and Hudson River Railroad Company, The Michigan Central Railroad Company, The Cleveland Cincinnati Chicago and St Louis Railway Company, The Pittsburgh and Lake Erie Railroad Company, and The Toledo and Ohio Central Railway Company to enter into an equipment trust agreement, to be dated January 1, 1913, for the purpose of establishing the New York Central Lines Equipment Trust of 1913. This agreement will provide for an issue of $24,000,000.00 of equipment trust certificates, bearing interest at the rate of 4½% per annum; being not to exceed 90% of the total cost of the equipment to be furnished under the terms of the said agreement. The certificates are to be paid in fifteen annual installments, the first installment being payable January 1, 1914. Out of the $24,000,000.00 of certificates authorized there will be issued, early in 1913, $12,540,000.00. The cost of the equipment to be assigned to this company in connection with the issue of these latter certificates will be approximately $1,006,000.00, and the pro-rata amount of the certificates, representing not to exceed 90% of the cost, will be approximately $879,000.00. Full particulars as to the character of the equipment to be acquired will be set forth in the report to the stockholders for 1913.

Cost of road and equipment on December 31, 1911, was.....		$131,078,914.00
It has been increased during the year as follows:		
Expenditures for additions and betterments to the property as shown in detail elsewhere.	$3,238,615.21	
Cost of equipment received during the year under the equipment trust of 1912.....	3,305,512.50	
Cost of 1,000 box cars purchased from the company's proportion of profit from operation of Pittsburgh McKeesport and Youghiogheny Railroad for years 1909, 1910 and 1911	777,311.07	7,321,438.78
		$138,400,352.78
Value of equipment retired from service during the year	$866,253.67	
Less amount charged for new equipment acquired, consisting of 7 passenger cars, 3 dining cars, 10 steel smoking cars, 1 pile driver, 1 coaling machine, 5 steam shovels and cost of applying superheaters to 41 locomotives..	444,726.90	
	$421,526.77	

Credit adjustment in connection with trust equipment to cover profit on parts and accessories, freight and inspection charges, etc...	222,767.30	
Value of twenty-five class G-6 locomotives acquired under 1910 equipment trust and transferred to The Michigan Central Railroad Company	483,524.95	1,127,819.02
		$137,272,533.76

Amount credited in 1912 for account of 1907, 1910 and 1912 equipment trust installments	1,505,784.97
Cost of road and equipment, December 31, 1912	$135,766,748.79

Grateful acknowledgment is made of the faithful, efficient performance of duty by employes in every department of the service during the year.

WILLIAM C. BROWN,
President.

SIXTY-SEVENTH ANNUAL REPORT OF THE MICHIGAN CENTRAL RAILROAD COMPANY.

To the stockholders of

THE MICHIGAN CENTRAL RAILROAD COMPANY:

The Board of Directors herewith submits its report for the year ended December 31, 1912, with statements showing the results for the year and the financial condition of the company.

The report covers the operation of the same mileage as the previous year, as follows:

	Miles
Main line	270.07
Proprietary lines	343.31
Leased lines	1,110.20
Lines operated under trackage rights	93.18
Total road operated (as shown in detail on another page)	1,816.76

There was no change in capital stock during the year, the amount authorized and outstanding being $18,738,000.00.

The funded debt outstanding December 31, 1911, was		$41,269,055.01
It has been increased during the year as follows:		
Pro-rata liability for certificates under the New York Central Lines Equipment Trust agreement of 1912	$2,275,663.50	
Additional liability for certificates outstanding under 1910 trust, account transfer of 25 locomotives from Lake Shore and Michigan Southern Railway Company	375,979.50	2,651,643.00
		$43,920,698.01
It has been decreased during the year as follows:		
Pro-rata of installment on New York Central lines equipment trust certificates of 1910, paid January 1, 1912	$339,098.22	
Pro-rata of installment on New York Central lines equipment trust certificates of 1907, paid November 1, 1912	260,425.45	
Michigan Central-Jackson, Lansing & Saginaw three and one-half per cent gold bonds of 1951 purchased and cancelled by the Trustees of the Land Grant Fund of the Jackson, Lansing & Saginaw Railroad Company	5,000.00	604,523.67
Total funded debt December 31, 1912 (detail on another page)		$43,316,174.34

The changes in the road and equipment account during the year were as follows:

Amount charged against main line to December 31, 1911			$48,361,257.59
Charged for additions and betterments in 1912, as shown in detail on another page:			
Against capital account:			
For road	$325,054.78		
For equipment	2,475,653.36	$2,800,708.14	
Against income account (appropriated surplus):			
For equipment	$482,909.55		
Less: For road (adjustment)	171.70	482,737.85	
		$3,283,445.99	
Less: Equipment replacement fund	$309,042.31		
Equipment trust installments	780,156.07	1,089,198.38	2,194,247.61
Total main line			$50,555,505.20
Amount charged against leased lines to December 31, 1911			$17,166,727.53
Credited for additions and betterments in 1912, as shown in detail on another page:			
To capital account:			
For road	$181,018.15		
To income account (appropriated surplus):			
For road	367,098.94	548,117.09	
Total leased lines			16,618,610.44
Total December 31, 1912			$67,174,115.64

On June 19, 1912, this company purchased the entire railroad and property of the Buchanan & St Joseph River Railroad Company for a nominal consideration, all of the stock of the latter company being owned by The Michigan Central Railroad Company, the railroad purchased consisting of a spur line 1.77 miles in length, situated in Buchanan, Berrien County, Michigan.

On November 1, 1912, this company subscribed to 1785.6 shares of the increased capital stock of the Toronto Hamilton & Buffalo Railway Company and paid for the same at par. The Toronto Hamilton & Buffalo Railway Company also liquidated its indebtedness to this company, amounting to $24,986.78.

Under an indenture dated October 1, 1912, between The Michigan Central Railroad Company, The Canada Southern Railway Company and the Guaranty Trust Company of New York, this company guarantees the payment of the principal and interest of $40,000,000.00 of Canada Southern fifty-year five per cent gold bonds, of which $22,500,000.00 have been issued and sold, the proceeds to be used in the redemption of $14,000,000.00 of first mortgage bonds of The Canada Southern Railway Company maturing January 1, 1913; $6,000,000.00 of its second mortgage bonds maturing March 1, 1913; and to pay for improvements to the property of The Canada Southern Railway Company made and contemplated.

On November 20, 1912, the Board of Directors authorized The Michigan Central Railroad Company to enter into an equipment trust agreement, to be dated January 1, 1913, for the purpose of establishing the New York Central Lines equipment trust of 1913. The cost of the equipment to be assigned to this company in connection with the issue of these latter certificates will be approximately $1,099,000.00, and the pro-rata amount of the certificates, representing not to exceed 90% of the cost, will be approximately $960,000.00. Full particulars as to the character of the equipment to be acquired will be set forth in the report to the stockholders for 1913.

On October 21, 1912, and in accordance with agreement dated October 1, 1912, supplemental to lease dated February 15, 1912 establishing the New York Central Lines Equipment Trust of 1910, the Lake Shore & Michigan Southern Railway Company transferred to this company twenty-five freight locomotives, in consideration of which this company assumed the remaining indebtedness on these locomotives amounting to $375,979.50, and made a cash payment of $103,679.75 for the value of the Lake Shore Company's equity in the equipment, less depreciation while in the service of the latter company.

The Detroit Delray & Dearborn Railroad Company, December 5, 1912, increased its capital stock from $50,000.00 to $375,000.00. The unissued portion of the original amount authorized and such amount of the additional issue as may be necessary to be issued and sold, will be used to pay for extensions and improvements to the property.

On December 17, 1912, this company disposed of its holdings of 30,000 shares of the common stock, and a promissory note amounting to $495,000.00 of the Chicago Indiana & Southern Railroad Company, to The Lake Shore & Michigan Southern Railway Company for a consideration of $1,000,000.00. As part consideration the Lake Shore Company also released this company from its guaranty of the principal and interest of $3,825,000.00 of fifty-year gold bonds of the Chicago Indiana & Southern Railroad Company.

The sale of two of the three Detroit River ferry boats, belonging to The Canada Southern Railway Company, and the one ferry boat belonging to this company, to the Wabash Railroad Company for a consideration of $200,000.00, was consummated November 15, 1912, the proceeds being apportioned between the two companies on basis of an impartial appraisal.

Under date of June 12, 1912, this company authorized a contribution of $82,000.00 to the Mackinac Transportation Company for its one-third proportion of the estimated cost of a new steel car ferry, the advances made on this account from time to time to be covered by the promissory notes of Mackinac Transportation Company.

SUMMARY OF FINANCIAL OPERATIONS AFFECTING INCOME.

RAILWAY OPERATING INCOME.	1912.	1911.	Increase or Decrease.
RAIL OPERATIONS—	1,816.76 *miles operated*	1,816.76 *miles operated*	
Revenues	$32,911,753.07	$30,164,490.16	$2,747,262.91
Expenses	23,008,755.63	21,345,754.85*	1,663,000.78
NET REVENUE RAIL OPERATIONS	$9,902,997.44	$8,818,735.31	$1,084,262.13
Percentage of expenses to revenue	(69.91%)	(70.76%)	—(.85%)
AUXILIARY OPERATIONS—			
Revenues	$663,850.55	$608,294.24	$55,556.31
Expenses	635,752.02	599,385.38	36,366.64
NET REVENUE AUXILIARY OPERATIONS	$28,098.53	$8,908.86	$19,189.67
NET RAILWAY OPERATING REVENUE	$9,931,095.97	$8,827,644.17	$1,103,451.80
RAILWAY TAX ACCRUALS	1,366,984.90	1,322,620.82	44,364.08
RAILWAY OPERATING INCOME.	$8,564,111.07	$7,505,023.35	$1,059,087.72
OTHER INCOME.			
Joint facility rent income	$207,114.02	$236,403.38	—$29,289.36
Miscellaneous rent income	2,093.84	3,259.77	—1,165.93
Dividend income	618,556.67	347,241.50	271,315.17
Income from funded securities	46,880.00	46,880.00	.....
Income from unfunded securities and accounts	186,018.65	525,154.01	—339,135.36
Miscellaneous income	.....	12,018.43	—12,018.43
TOTAL OTHER INCOME	$1,060,663.18	$1,170,957.09	—$110,293.91
GROSS INCOME	$9,624,774.25	$8,675,980.44	$948,793.81
DEDUCTIONS FROM GROSS INCOME.			
Deductions for lease of other roads	$1,794,951.00	$1,605,443.67	$189,507.33
Hire of equipment—debit balance	1,099,646.52	652,736.44	446,910.08
Joint facility rent deductions	560,795.72	583,551.98	—22,756.26
Miscellaneous rent deductions	3,013.41	6,816.35	—3,802.94
Miscellaneous tax accruals	11,286.84	.....	11,286.84
Separately operated properties—loss	245,802.66	174,887.13	70,915.53
Interest deductions for funded debt	2,989,956.28	2,911,715.81	78,240.47
Interest deductions for unfunded debt	192,988.94	624,464.64	—431,475.70
TOTAL DEDUCTIONS	$6,898,441.37	$6,559,616.02*	$338,825.35
NET INCOME	$2,726,332.88	$2,116,364.42	$609,968.46
DIVIDENDS, TWO, AGGREGATING 6%.	1,124,280.00	1,124,280.00	.....
SURPLUS	$1,602,052.88	$992,084.42	$609,968.46

*Revised for purposes of comparison.

AMOUNT TO CREDIT OF PROFIT AND LOSS (FREE SURPLUS) DECEMBER 31, 1911		$11,228,059.49
SURPLUS FOR THE YEAR 1912		1,602,052.88
		$12,830,112.37
ADD:		
Advances for improvements charged to income, now to be covered by capital of The Detroit Delray & Dearborn Railroad and The Canada Southern Railway companies	$740,353.77	
Sundry adjustments and cancellations (net)	70,951.54	811,305.31
		$13,641,417.68

DEDUCT:		
Ten per cent payments account equipment trust of 1912	$252,851.50	
For abandoned property	107,972.09	
Discount, commission and expenses equipment trust certificates of 1912, and one-year four per cent notes	52,051.81	412,875.40
BALANCE TO CREDIT OF PROFIT AND LOSS (FREE SURPLUS) DECEMBER 31, 1912		$13,228,542.28

The total operating revenues were $32,911,753.07, an increase of $2,747,262.91 as compared with the previous year.

The freight revenue was $21,318,204.50, an increase of $1,779,520.50. This was due to the increased movement of nearly all commodities, the largest increases being in the tonnage of grain, fruit, bituminous coal, stone, lumber, bar and sheet metal, and miscellaneous commodities.

The passenger revenue was $8,250,336.10, an increase of $643,284.14. A large increase in the number of immigrant and other interline passengers more than offset the decrease in the number of local passengers carried, and is reflected in the increase in the average distance each passenger was carried. This additional interline business, together with the discontinuance, to a large extent, of the low-rate excursion travel, caused a slight increase in the average revenue per passenger per mile.

The express revenue was $1,610,393.82, an increase of $131,944.67 compared with the previous year, due to an enlarged volume of business.

The revenue from the transportation of mails was $434,330.74, an increase $22,630.19 due to an under estimate of $16,586.00 in 1911, and additional compensation effective July 1, 1911, of $6,044.19 allowed by the United States Government, based on re-weighing of mails.

The operating revenue from all other sources increased $169,883.41 over the previous year; the principal items of such increase being in switching $103,105.09, car service $30,676.76, other passenger train $20,899.95, excess baggage $6,941.83, storage-freight $6,106.01 and milk (on passenger trains) $2,506.52, partly offset by a decrease in rents of buildings and other property $4,579.08.

The total expenses of operation were $23,008,755.63, an increase of $1,663.000.78, as per detail on following pages. By groups and principal fluctuations they were as follows:

Maintenance of way and structures $3,629,732.27, an increase of $80,527.60, caused principally by larger force employed at higher rate of wages in maintenance of roadway, and removal of snow and ice; increased expenditure for track material, and for renewal of signals and buildings, offset by decreased prices in rails and ties, and decrease in bridge work caused by delay in obtaining material.

Maintenance of equipment $4,711,843.11, an increase of $311,547.10, caused principally by heavy repairs to locomotives, partly offset by decreased charges in car repairs.

Traffic expenses $764,733.21, a decrease of $18,865.93, due principally to decreased charges account of Fast Freight Lines, and in the cost of advertising; offset by increased cost of supervision and maintenance of outside agencies, and by large increase in expenditures for stationery and printing, due to tariff requirements.

Transportation expenses $13,313,058.72, an increase of $1,263,955.38, principally due to handling increased business and to higher wages paid to station employes, telegraphers and towermen. Expenses were abnormally large during the first four months of the year owing to unusual weather conditions and inadequate facilities at important terminals, which brought about a congested condition of transportation that lasted into the middle of the year.

General expenses $589,388.32, an increase of $25,836.63.

There was an increase in the revenue from outside operations of $19,189.67 over the previous year derived principally from dining car service and restaurants, and operation of stock yards.

The operating income was $8,564,111.07, an increase of $1,059,087.72.

Other income was $1,060,663.18, a decrease of $110,293.91 as compared with the previous year, of which $339,135.36 was due to a smaller return in interest on unfunded securities, caused principally by the liquidation of promissory notes of the Detroit River Tunnel Company, and also to a decrease in rentals of $30,455.29 and in miscellaneous income of $12,018.43, offset by an increase of $271,315.17 in dividends on stocks owned.

Deductions from income amounted to $6,898,441.37, an increase of $338,825.35. The principal fluctuations were increases of $189,507.33 in rental of the Detroit River Tunnel, $446,910.08 in hire of equipment, $76,250.89 in interest on equipment trust certificates, $72,838.39 in operating guarantee of Merchants Despatch Transportation Company, $11,286,84 in miscellaneous taxes, partly offset by decreases of $431,475.70 in interest on unfunded debt and $26,559.20 in rentals.

The profit from operation for the year, after payment of six per cent in dividends upon the capital stock, was $1,602,052.88 which has been carried to the credit of profit and loss.

The credits for retired equipment during the year amounted to		$367,745.00
The charges against this account for cost of one cafe coach, new bridge derrick, one caboose car and superheaters, betterments, etc., aggregated	58,702.69	
	$309,042.31	
Credit balance equipment replacement fund December 31, 1911	32,194.36	
Total credit balance December 31, 1912		$341,236.67

During the year $1,067,500.00 was expended for the increase and improvement of terminal facilities in and about Detroit.

The tunnel under the Detroit River has been in constant use during the year, and has proved to be an unqualified success from every point of view.

The work upon the extensive terminal station has progressed rapidly and favorably, and unless some unforeseen obstacle prevents, it is expected that it will be completed and ready for occupancy before January 1, 1914.

During the year this company issued its one-year promissory notes due March 1, 1913, for $4,000,000.00, bearing interest at the rate of four per cent per annum.

An arrangement was made with the Lake Shore & Michigan Southern Railway Company, effective November 24, 1912, for the reciprocal grant of running rights over the single track railroads of the two companies between Detroit and Toledo, whereby the two roads will be operated separately and independently as before, but with the greater safety, efficiency and convenience of double track operation.

In the operation of the Pension Department 44 employes were retired and placed upon the pension rolls. Of these retirements 30 were authorized because of the attainment of seventy years of age and 14 because of total and permanent physical disability. Twelve pensioners died during 1912 and at the close of the year 194 retired employes were carried upon the pension rolls. The average monthly pension allowance to these men was $22.37 and the total amount paid in pension allowances during the year was $50,953.53.

Grateful acknowledgment is made of the faithful, efficient performance of duty by employees in every department of the service during the year.

WILLIAM C. BROWN,
President

TWENTY-FOURTH ANNUAL REPORT OF THE CLEVELAND CINCINNATI CHICAGO AND ST LOUIS RAILWAY COMPANY.

To the stockholders of
THE CLEVELAND CINCINNATI CHICAGO & ST LOUIS RAILWAY COMPANY:

The Board of Directors herewith submits its report for the year ended December 31, 1912, with statements showing the results for the year and the financial condition of the company.

The mileage embraced in the operation of the road is as follows:

	Miles
Main line and branches owned	634.86
Proprietary lines	994.49
Leased lines	248.27
Trackage rights	134.02
Total road operated	2,011.64

A statement showing in detail the mileage of road operated will be found on another page.

There was no change in the capital stock during the year, the amounts authorized and outstanding on December 31, 1912, being as follows:

Preferred stock authorized		$10,000,000.00
Common stock authorized		50,000,000.00
Total preferred and common stock authorized		$60,000,000.00
Preferred stock issued and outstanding	$10,000,000.00	
Common stock issued and outstanding	47,056,300.00	57,056,300.00
Balance common stock authorized but not issued, December 31, 1912		$2,943,700.00

The funded debt outstanding December 31, 1911, was $87,357,685.34

It has been increased during the year as follows:

C C C & St L Ry general mortgage bonds, issued for additions, improvements, double tracking, equipment, etc	$1,000,000.00	
C C C & St L Ry general mortgage bonds, issued for retirement of prior lien bonds	579,000.00	
To place upon the general books of the Company its pro rata liability in connection with the certificates issued under the New York Central Lines Equipment Trust Agreement of 1912	2,398,353.00	
Real Estate mortgage, Cincinnati, Ohio, Rachel G. Holmes	9,000.00	3,986,353.00
		$91,344,038.34

It has been decreased during the year as follows:

I & St L Ry first mortgage bonds retired	$500,000.00	
Pro rata equipment trust certificates due January 1, 1912	199,625.82	
Pro rata equipment trust certificates due November 1, 1912	246,689.81	
C I St L & C Ry Co first mortgage bonds retired	6,000.00	
C I St L & C Ry Co general first mortgage bonds retired	73,000.00	
C C C & St L Ry Co 5% Gold notes retired	12,000.00	
C S & C R R Co bonds eliminated from funded debt, the interest thereon being treated as rent paid for lease of that property	2,571,000.00	3,608,315.63
Total funded debt outstanding December 31, 1912		$87,735,722.71

On November 20, 1912, the Board of Directors authorized The Cleveland Cincinnati Chicago and St Louis Railway Company to enter into an equipment trust agreement, to be dated January 1, 1913, for the purpose of establishing the New York Central Lines equipment trust of 1913. Out of the $24,000,000.00 of certificates authorized there will be issued, early in 1913, $12,540,000.00. The cost of the equipment to be assigned to this company in connection with the issue of these latter certificates will be approximately $1,258,000.00, and the pro rata amount of the certificates, representing not to exceed 90% of the cost, will be approximately $1,098,000.00. Full particulars as to the character of the equipment to be acquired will be set forth in the report to the stockholders for 1913.

SUMMARY OF FINANCIAL OPERATIONS AFFECTING INCOME.

OPERATING INCOME.	1912.	1911.	Increase or Decrease.
RAIL OPERATIONS—	2,011.64 *miles operated*	2,011.64 *miles operated*	
Revenues	$32,714,238.27	$30,431,914.86	$2,282,323.41
Expenses	24,359,744.53	22,685,707.81	1,674,036.72
NET REVENUE RAIL OPERATIONS	$8,354,493.74	$7,746,207.05	$608,286.69
Per cent of revenue	(74.46%)	(74.55%)	—(0.09%)
AUXILIARY OPERATIONS—			
Revenues	$378,302.75	$355,626.95	$22,675.80
Expenses	406,785.17	401,713.41	5,071.76
NET DEFICIT AUXILIARY OPERATIONS	$28,482.42	$46,086.46	$17,604.04
NET OPERATING REVENUE	$8,326,011.32	$7,700,120.59	$625,890.73
RAILWAY TAX ACCRUALS	1,190,242.60	1,062,512.28	127,730.32
OPERATING INCOME	$7,135,768.72	$6,637,608.31	$498,160.41

OTHER INCOME.			
Joint facility rent income	$341,589.44	$319,639.86	$21,949.58
Miscellaneous rent income	219,016.81	207,988.31	11,028.50
Dividends on stocks owned	40,967.17	72,764.90	—31,797.73
Interest on bonds owned	35,040.00	46,120.00	—11,080.00
Interest on notes, loans, etc	73,645.08	52,769.25	20,875.83
Miscellaneous income	34,490.00	8,448.94	26,041.06
Interest on sinking fund bonds owned	12,060.00	.....	12,060.00
TOTAL OTHER INCOME	$756,808.50	$707,731.26	$49,077.24
GROSS INCOME	$7,892,577.22	$7,345,339.57	$547,237.65
DEDUCTIONS FROM GROSS INCOME.			
For lease of other roads	$301,362.02	$132,500.00	$168,862.02
Hire of equipment—debit balance	505,122.44	763,307.31	—258,184.87
Joint facility rent payable	482,920.65	526,794.42	—43,873.77
Miscellaneous rent payable	140,960.66	141,710.61	—749.95
Miscellaneous tax accruals	2,970.00	.....	2,970.00
Separately operated properties—loss	71,710.76	42,014.85	29,695.91
Central Indiana Ry—deficit	54,245.00	56,300.00	—2,055.00
Interest on funded debt	3,820,898.87	3,747,347.55	73,551.32
Interest on unfunded debt	154,439.39	80,324.24	74,115.15
Amortization of discount on funded debt	.....	53,425.00	—53,425.00
Miscellaneous deductions	1,535.68	.....	1,535.68
Appropriation of income to sinking fund	12,060.00	.....	12,060.00
TOTAL DEDUCTIONS FROM GROSS INCOME	$5,548,225.47	$5,543,723.98	$4,501.49
NET INCOME	$2,344,351.75	$1,801,615.59	$542,736.16
Dividends preferred, four, aggregating 5%	500,000.00	500,000.00	.....
SURPLUS FOR THE YEAR	$1,844,351.75	$1,301,615.59	$542,736.16

Amount to credit of profit and loss (free surplus) December 31, 1911		$2,169,152.60
Surplus for the year 1912		1,844,351.75
		$4,013,504.35
DEDUCT:		
Discount on C C C & St L gen mtg bonds	$100,000.00	
Commissions on 1910 and 1911 gold deb bonds	273,371.53	
Income November 1890 to May, 1912, from St Louis Div sinking fund bonds (adjustment)	341,500.00	
Interest January 1, 1883 to July 1, 1888 on Kankakee & Seneca 1st mtg bonds (uncollectible)	117,000.00	
Accumulated advances to Mount Gilead Short Line Ry Co (uncollectible)	26,864.29	
Adjustment of Chicago Indianapolis & St Louis Short Line Ry—advance account	167,624.89	
Value of property abandoned 1905 to 1912	1,385,110.00	
Adjustment of sundry accounts	104,093.67	2,515,564.38
BALANCE TO CREDIT OF PROFIT AND LOSS (FREE SURPLUS) DECEMBER 31, 1912		$1,497,939.97

The gross operating revenues for the year, $32,714,238.27, were the largest in the history of the company, showing an increase over the preceding year of $2,282,323.41, of which amount $2,215,691.44 was in transportation revenue and $66,631.97 in revenue from operations other than transportation.

The freight revenue for the year was $22,168,002.10, an increase of $2,234,706.23, or 11.21 per cent. There was moved an aggregate of 25,816,649 tons of revenue producing freight, an increase of 2,477,059 tons over the previous year, of which 1,594,932 tons was in the products of mines, 181,829 in the products of forests, the remainder of the increase being distributed among the other commodities. The average receipts per ton per mile were 5.43 mills, as compared with 5.50 mills in the previous year, a decrease of .07 mills. The average haul per ton increased 2.9 miles and the average number of tons of revenue freight per train mile increased 29 tons, while the average number of freight cars per train mile decreased 1.7 cars.

Passenger revenue decreased $41,119.12, there being a decrease in interline business of $44,868.34 and an increase in local business of $3,749.22. The average amount received from each passenger increased 1.1 cents and the average receipts per passenger mile increased from 1.825 cents to 1.902 cents, or .077 cents. There were 122,684 less passengers carried in 1912; the average distance carried decreased 1.7 miles and there was a decrease of 19,532,803 in passengers carried one mile.

Of the decrease of $67,128.25 in mail revenue, $32,070.11 was the result of decrease in mail compensation allowed by the Government, the balance of the decrease resulting from adjustment made in the mail revenue accounts for the previous year.

The increase in express revenue, $63,583.84, represents this company's proportion of the earnings from increased express traffic as compared with the preceding year.

Revenue from milk traffic carried on passenger trains increased $16,880.14 and reflects the efforts made to develop this character of traffic during the year, together with the improved facilities for handling same, afforded by the new baggage cars received during the year.

Revenues from operations other than transportation increased $66,631.97, of which $34,250.94 is from car service (demurrage) and $30,777.56 in miscellaneous revenue.

The operating expenses for the year aggregate $24,359,744.53, an increase of $1,674,036.72, detail of which by groups is as follows:

Maintenance of way and structures—increase	$544,944.96
Maintenance of equipment repairs—increase	320,750.34
Maintenance of equipment renewals—increase	133,026.85
Traffic expenses—decrease	52,084.89
Transportation expenses—increase	739,641.38
General expenses—decrease	12,241.92
Net increase	$1,674,036.72

The increase in maintenance of way and structures, while general through all of the accounts results principally from the increased expenditures for rails, ties and other track material, and in roadway and track, the latter account increasing $261,828.62. Included in this amount is an increase of nearly $180,000.00 in the pay rolls of the various divisions and approximately $59,800.00 covering abnormal expenditures for labor and material growing out of flood conditions in the vicinity of Cairo. The aggregate increase in pay rolls of this department was $373,495.25.

The increase in maintenance of equipment repairs is distributed to substantially all of the accounts, pay rolls of this department increasing $281,252.94.

Of the increase in charges to renewals of equipment, amounting to $133,026.85, $30,171.05 is in passenger cars, of which there were 10 retired this year against 8 last year, $198,546.05 in freight cars, of which there were 901 retired this year against 642 last year, and $18,047.04 in work equipment, of which there were 65 units retired in 1912 against 57 in 1911. These amounts are partially offset by a decrease of $113,737.29 for locomotive retirements, there having been retired but 14 locomotives this year, as compared with 39 in the preceding year.

The decrease in traffic expenses was $52,084.89, the important decreases being in superintendence, advertising, fast freight lines and stationery and printing.

Transportation expenses increased $739,641.38, of which $394,513.49 was in pay rolls and is due to increased force in this department, together with increased compensation paid certain classes of labor due to changes in rates of pay. The increases extend to practically all of the accounts in this group and reflect the increases in tonnage, locomotive, car and train mileage. The principal item of decrease $88,602.18 is in injuries to persons, due to abnormal payments in the preceding year.

General expenses decreased $12,241.92, the principal items of decrease being law expenses $17,173.11, salaries and expenses of general officers $5,635.94, stationery and printing $4,460.05, partially offset by increase in pensions $10,684.73, insurance $10,484.80 and salaries of clerks and attendants $5,112.51.

The net deficit from auxiliary operations decreased $17,604.04, practically all of which is in the dining car service, from which the revenues increased $25,514.65 while expenses increased but $7,540.14.

Taxes increased $127,730.32, of which $64,619.40 is on real estate in Ohio, $27,565.19 on real estate in Indiana, $31,970.13 on real estate in Illinois, the balance being fluctuations in taxes of other character.

Operating income for the year was $7,135,768.72, an increase of $498,160.41 over the preceding year. Other income was $756,808.50, an increase of $49,077.24, due to increased joint facility and miscellaneous rent income and increased interest on deposits, partially offset by decrease of $31,797.73 in dividends on stocks owned. Gross income was $7,892,577.22, an increase of $547,237.65 over previous year.

Deductions from gross income increased $4,501.49, of which the more important items are: increased interest on general mortgage bonds $43,152.99, on gold debenture bonds $105,625.00, interest on equipment trust certificates—1912 $106,726.70, increase in interest on notes $74,115.15, partially offset by decrease of $258,184.87 in hire of equipment debit balance and decrease of $43,873.77 in joint facility rent payable.

The surplus for the year after paying a dividend of $500,000.00, representing 5% on the preferred stock, was $1,844,351.75, an increase of $542,736.16.

There was expended during the year for additions to the property, improvements, double tracking, equipment, etc., and charged to cost of road and equipment, the sum of $3,048,573.13, a detailed statement of which will be found upon another page.

Action was taken during the year by the stockholders and the directors of the several companies authorizing the conveyance to this company, under the Ohio statutes, of the entire properties of the Cincinnati & Springfield Railway Company, Columbus Springfield & Cincinnati Railway Company, Harrison Branch Railroad Company and Findlay Belt Railway Company; also the conveyance to this company, under the laws of Illinois and of Indiana, of the entire properties of the Cairo Vincennes & Chicago Railway Company and Chicago Indianapolis & St. Louis Short Line Railway Company.

Upon the execution of the several deeds of conveyance so authorized the properties of the six companies mentioned above will become a part of the property of this company as completely and effectually as if the several companies had become merged with this company, but subject, nevertheless, to the liens upon said property severally at the time of such conveyance.

At the annual meeting of the stockholders of the company, held at Cincinnati, Ohio, October 30, 1912, a resolution providing for the guarantee, by the Cleveland Cincinnati Chicago & St Louis Railway Company, of the payment of principal of five million ($5,000,000.00) dollars, par value, of the fifty year first mortgage gold bonds of the Evansville Mt Carmel & Northern Railway Company, and interest thereon, to be issued from time to time under the mortgage executed by that company to the Guaranty Trust Company of New York, Trustee, dated November 1, 1910, maturing July 1, 1960, and bearing interest at the rate of four and one-half per cent (4½%) per annum, received an affirmative vote of more than two-thirds of the entire capital stock of the company issued and outstanding, and having been consented to by more than a majority interest of the holders of the preferred stock, was duly adopted.

During the year an agreement was entered into with the Guaranty Trust Company of New York, providing for the purchase by the Trust Company, for the benefit of this company, of approximatcly 76,000 acres of coal lands in the State of Illinois, upon which advance payments of $150,000.00 were made by this company, the balance of the cost to be paid July 1st, 1917, at which time the deed or deeds of such lands are to be delivered by the Trust Company. Preliminary expenditures to the amount of $54,243.84 have been made for drilling, etc.

On March 12, 1912, this company entered into an agreement with the Erie R. R. Co., whereby each company uses the main track of the other between Dayton, O., and Cold Springs, O., a distance of about 19.5 miles, thereby making a double track arrangement which became operative October 15.

To enable the passenger trains of this company to reach a connection with the tracks of the Cincinnati, Hamilton & Dayton Ry. Co. and to operate such trains to and from the Union Depot at Toledo, this company, on April 8, 1912, entered into an agreement with the Toledo & Ohio Central Ry. Co. providing for the use by this company as a tenant of the latter company of about 3,700 feet of the main track of the Pennsylvania Co.

A careful analysis of the Property Investment account of this company has resulted in several adjustments affecting the Road and Equipment, Securities and Advances Accounts, to conform to the accounting requirements of the Interstate Commerce Commission, and involving the charging off against profit and loss of the value of certain property abandoned, all of which adjustments are reflected in the balance sheet, shown elsewhere in this report.

In the operation of the Pension Department 44 employees were retired and placed upon the pension rolls. Of these retirements, 25 were authorized because of the attainment of seventy years of age and 19 because of total and permanent physical disability. Nineteen pensioners died during 1912 and at the close of the year 197 retired employees were carried upon the pension rolls. The average monthly pension allowance to these men was $20.32 and the total amount paid in pension allowances during the year was $46,617.28.

Grateful acknowledgment is made of the faithful, efficient performance of duty by employees in every department of the service during the year.

WILLIAM C. BROWN,
President.

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WE GUARANTEE, that of this issue 10,475 copies were printed; that of those 10,475 copies, 9,869 copies were mailed or delivered by messenger to regular paid subscribers; 425 copies were distributed among members and guests of the American Railway Engineering Association and at the Coliseum; 131 copies were mailed to advertisers; and 50 copies were set aside for office use.

CONTENTS:

The Committee on Buildings deserves much credit for the report on Roof Covering, which was presented yesterday. Beginning with practically no accurate information some three years ago, the committee has devoted much time to this subject and brought out a very valuable comparison of the various materials. Roofing materials are largely trade products made under highly competitive conditions and by patented processes. Because of this the makers have been unwilling to give out information regarding their products, and the committee has labored under serious difficulties. The report is especially valuable, as it deals with materials which the average engineer is called upon to specify to a considerable extent and which, as a rule, he knows little about. It should, therefore, be of great assistance in determining the relative merits of the various products for specific purposes. The bringing out of much of this information should largely eliminate unfair competition and put the roofing business upon a higher basis where the purchaser may better know that when he orders a certain product he will receive it.

The methods of graphical analysis of the throat and station track capacity of large passenger terminals presented by the Yards and Terminals Committee yesterday morning, brought out information which should be highly useful in the design of large passenger stations or in the study of traffic conditions for the purpose of locating and relieving congestion. While a study of this nature is of direct value to only a small proportion of the railway engineers, it is of very great value to that small proportion having in charge the design or operation of large terminals. The three methods outlined for studying this special problem should form a basis on which such studies can be readily made and should also be of considerable assistance in making comparisons upon the same basis of traffic conditions at different terminals.

The directors of the Railway Business Association, following their meeting in Chicago on Wednesday, gave out a statement strongly advocating the amendment of the Erdman act at the special session of Congress which has been called by President Wilson. The association favors broadening the provisions of the law so as, among other things, to include mediation and arbitration of disputes among railways and their track employes. It will be recalled that the law now applies only to controversies between the roads and employes concerned directly with the operation of trains. The Railway Business Association believes it should be made applicable to trackmen, clerks, freight-handlers, machinists, boiler-makers, blacksmiths, car-repairers, etc. It also favors the creation of a board in which "the proportion of the neutral arbitrators to partisans will bring more minds to bear upon the many questions arising in large areas and tend to promote equity in decisions." Under the law as it now stands the arbitration board consists of one representative of the railways, one of the employes and an umpire, the last-named of whom really always decides the controversy. The defects of the existing law are conceded by practically all who have studied its workings. The country recently has very narrowly escaped several bad strikes, and something should be done speedily to remove the constantly recurring menace of serious interruptions of transportation service. There are few, if any, more important matters demanding attention by Congress.

In a number of ways the fourteenth annual convention of the American Railway Engineering Association, which closes to-day, has been better than any of the previous meetings. The number of members in attendance is greater than ever before, as shown by the official registration figures. In 1911, 351 members registered; in 1912, 386, and this year 434. This year's registration is more than 40 per cent of the total membership of the association, which was announced by President Wendt in his inaugural address to have reached 1,115. The attendance in the meetings has been uniformly good, even at the opening of the sessions. The meetings have been carried through on schedule time and the final adjournment of the sessions for hearing reports and discussions was made at the unusually early hour of 12:35 yesterday. One reason for the very large attendance at the sessions of the convention is that the association has this year, for the first time, officially recognized on its programme the exhibition at the Coliseum. The programme included four days, Friday being devoted to a "visit to the National Railway Appliances Exhibition

in the Coliseum and Armory." The officers of the Appliances Association notified all exhibitors that the exhibition would close officially at 10:00 o'clock to-night (Friday), and that exhibits must be left intact up to that time. The knowledge that this was the case has caused many of the members of the engineering association to postpone their visit to the exhibition until Friday, which has allowed them to spend all of their time in the meetings of the convention. The attendance has also been augmented by a very general interest in the reports presented this year. Some of these were among the most important which the association's committees have yet prepared. The Track Committee had a long and detailed report, including much important matter. The Yards and Terminals Committee presented some very valuable data concerning the study of operating conditions of large passenger terminals, and also presented a good report on some features of the operation of hump yards. The report of the Iron and Steel Structures Committee covered the very important matter of inspection; the Committee on Buildings completed the report on roofing materials, and the Rail Committee maintained the very high standard that its previous reports have set. The retiring president, Mr. Churchill, and all the officers and committees of the association, are to be congratulated on the successful conclusion of the year's work.

The report of the committee on Electricity brought up a subject the importance of which is not generally realized by those not fully conversant with the subject of steam road electrification. Many consider that when the electrification of the tracks is completed, the only remaining problems are those of an operating nature. The elaborate precautions taken to guard against the attacks of electrolysis in the Grand Central terminal show that engineering problems of magnitude also remain to be solved. While the subject of electrolysis has required attention ever since street cars have been operated by electricity, and it has been found that stray currents have been the cause of frequent destruction of conduits and water pipes, the full effects of this destructive action have not always been realized when the advisability of the use of electricity in steam railway terminals has been discussed. Difficulties of this nature from the surface lines in many cities have been pronounced, and, notably in Chicago, have given rise to many complaints and careful study within the past year. With the much larger amounts of power required for heavy railway service, these troubles may be greatly intensified and care will be necessary to avoid damage to private property as well as to the railway structures themselves. The committee on Electricity has an interesting subject, which will become increasingly important to steam railroad men as the mileage of electrified tracks increases.

NEED FOR DATA REGARDING TRACK CONSTRUCTION.

An examination of the reports of the committees studying the various elements of the track structure indicates that there is a very general sentiment that the time has come when more accurate data should be collected regarding the stresses to which the track is subjected and the strength of the individual parts singly and together. The Ballast committee reports that as a result of its study "a further test in track under regular traffic is desirable," and has outlined in some detail how such a test should be conducted to determine the proper depth of ballast of various kinds to insure uniform distribution of loads on the roadway. The Roadway committee renews the recommendation made by it a year ago that a special committee consisting of members of the Roadway, Ballast and Track committees be appointed to make experiments to determine the magnitude and distribution of the load transmitted to the roadbed and the bearing power of various materials ordinarily found in the construction of the roadway. Because of the close relation between the roadbed, ballast, ties and rail, such an investigation must cover the entire track structure, for it is impossible to study the action of any one part alone. The use of a heavier rail decreases the load upon the individual tie by distributing it over a greater number of ties. Likewise, an increased depth of ballast distributes the load more evenly upon the roadbed. The Tie committee bears this in mind when it reiterates the statement made a year ago that it is impracticable to make successful experiments to determine the size of crossties because of the influence of these other variables.

The rapidly increasing cost of maintenance of track shows plainly that it is less able to withstand the demands made upon it from year to year, and some remedy is necessary. In spite of the many years that railway tracks have been built and maintained there is practically no data regarding the actual service track can withstand. A number of excellent theoretical analyses have been made and some elaborate experiments have been carried out, notably those of the Pennsylvania at Altoona and of Director Schubert in Germany. These experiments, however, have been conducted largely under artificial conditions with the track equipment especially constructed and with assumptions more or less accurate regarding the loads, climatic and other conditions, so that the results only approximate those secured under traffic.

Before the track structure can be intelligently designed, the forces acting on it must be known. The track of to-day is not the result of such a design, but rather of a gradual development along more or less arbitrary lines. As it is becoming more evident that the limit of this development along the present lines will soon be reached, if indeed it has not already been reached, a series of tests carried on in a main track under actual traffic conditions should be extremely valuable in indicating the weak points in the present construction and showing wherein it may be strengthened. Aside from the necessity of securing a track structure of sufficient strength to meet present traffic conditions, it should be possible, with such tests, to determine the most economical construction to withstand given loads, so that one could determine, for instance, whether it is more economical to use a greater depth of ballast or larger ties to secure the desired resistance. One road is now making a careful study along this line, paying particular attention to the influence of the subgrade on the track structure above. It aims to divide the roadbed into four general classifications, depending upon its degree of solidity. Then, with a certain grade of foundation, one depth of ballast and one size and spacing of ties could be recommended to give a strength equal to that of another depth of ballast on another roadbed. A series of experiments to cover all the variables entering into track construction would necessarily be extensive and expensive, but when one considers the amount of money spent annually for track maintenance it should be well worth the cost. Because of these numerous variables, it is not to be expected that a section of track can ever be designed with the mathematical exactness that a bridge can, but a good series of tests should go a long way towards removing many of the uncertainties and bring us nearer to an exact solution.

MISSOURI PACIFIC-IRON MOUNTAIN DINNER.

The officers of the Missouri Pacific-Iron Mountain system who were present at the convention held their annual dinner Tuesday noon. The representatives of the system who were present included Messrs. Hadley, Leighty, Hale, Carpenter, Dorley, Curd, Burton, White, Rickert, Buckholz, Walker, Simons, Butterworth and Bishoff.

Proceedings.

The Thursday morning session of the American Railway Engineering Association was called to order at 9:20 a. m. by President Churchill.

YARDS AND TERMINALS.

The Board of Direction has assigned the following subjects to this committee:

(1) Report on typical situation plans of passenger stations, of both through and stub types, with critical analysis of working capacity, and include a review of the different methods of estimating their capacity.

(2) Report on developments in the handling of freight by mechanical means.

(3) Report on developments in the design and operation of hump yards.

TYPICAL SITUATION PLANS OF PASSENGER STATIONS.

In the development of the subject the committee presented situation plans and description of the business handled at the following passenger stations: Baltimore, B. & O.; Baltimore, Pennsylvania; Boston, South Station; Philadelphia, B. & O.; St. Louis, Union Station; and Washington, Union Station.

C. H. SPENCER,
Chairman Committee on Yards and Terminals.

In arriving at a description of the business handled at each station, the following outline has been used:

Handling of mail, handling of express, handling of baggage—individual, theatrical; passengers, through, local and suburban.

Each item should be considered apart from any other, particularly as to that which fixes the maximum capacity in a certain unit of time, say, one hour. This would be followed by consideration as to whether this speed or maximum capacity could be sustained for a longer period. Finally the four headings would be considered as applied to each layout.

The committee offers three methods of graphical critical analysis of working capacity of throat and station tracks at a station. The first method has been used by the Belgian state railway and is shown in article by Messrs. Weissenbruch and Verdeyen in Bulletin of International Railway Congress, for September, 1908. The second method has been used by the Pennsylvania railroad in studies of the Broad Street (Philadelphia) station. The third method has been designed for the committee work this year.

A method devised for the Dirschau Passenger station and described in Bulletin of International Railway Congress, for February, 1909, is, after consideration, not recommended.

The essentials to be shown on diagram for analysis of working capacity of a passenger station are:

(1) Occupation of station tracks—
- (a) Capacity of each track;
- (b) Time of occupation;
- (c) Make-up of trains;
- (d) Movements, if any, on internal crossovers in station.
- (e) Number of trains and route arriving and departing and direction of movement.

(2) Movements on throat tracks—
- (a) Arbitrary time over route;
- (b) Whether scheduled trains, drafts, road engines or switch engines;
- (c) Route used before entering and after leaving and direction of movements;
- (d) Interference from cross movements.

Each of the three methods submitted has stood the test of application to extremely heavy traffic conditions.

Diagram of Train Movements at Camden Station, Baltimore, Md., Using Belgian Diagram.

A diagram was presented showing train movements at the Camden station of the Baltimore & Ohio, which was an application of the diagram used on the Belgian State railways, and worked out by officers of that system. It was explained by L. Weissenbruch and J. Verdeyen in the Bulletin of the International Railway Congress issued in September, 1908.

In applying this diagram to Camden station there were certain minor features added to those given in the above bulletin, especially the table showing the capacity of tracks and the symbols used to designate the number and kind of cars occupying the platform tracks. This was for the purpose of showing whether or not two trains could occupy the platform track at the same time.

In the diagram of Camden station two hours were selected in which the number of movements was at a maximum. Many of these movements were switching movements, and during the particular time chosen the station platforms were not utilized to their full capacity for inbound and outbound main line trains. This period was selected and the diagram prepared to show especially the possibility of representing internal switching movements as well as the movements of trains and light road and switching engines.

The diagram as applied to Camden station showed its use both for a terminal station and a through station, since tracks 1 to 7 inclusive are stub tracks in the train shed, while tracks 8 and 9 are on a lower level entering the Belt Line tunnel on the main line between Philadelphia and Washington, constituting a through station.

The fundamental idea of the Belgian diagram is to select a certain number of platform tracks, access to which is secured over one track, or a short stretch of a track, which can be called the "running line" of the group selected. Tracks 8 and 9 show in reality a through station, and therefore, have two running lines. In order to represent routes and to immediately detect movements which would foul each other, numbers are selected to indicate the different routes.

The value of the diagram depends entirely upon the selection of the running lines and the numbers representing routes. The route numbers and the station platform numbers can be made different in design, and running lines should be shown in dotted and broken lines or in lines of different colors. There may be several selections of running lines and routes, but after one or two trials the arrangement that gives the greatest station capacity will be easily determined.

This diagram covered the five essentials which had been submitted by the committee as necessary for a graphical analysis of working capacity of a passenger station in regard to the occupation of station tracks. In the table at the right-hand side of the diagram the capacity of each track could be ascertained. It showed the composition of the train or cut of cars occupying the track and the length of time that the different trains or cuts occupied that track, and whether cars were taken off or added to those on the track. It showed internal movement, also the number and route of arriving and departing trains with their direction. As applied to the movement through throat tracks or fouling points, the numbers were placed at these fouling points and showed the route, the arrows the direction of movements, and the symbols as noted in the legend the class of movements, such as trains, light load or switching engines, or switching engines with a cut of cars. The time taken by a movement on any track was shown by the length of the heavy movement line as drawn on the line representing that track on which the movement is taking place.

All diagrams at first seem quite complicated, but after giving a little time to thoughtful study and becoming

thoroughly familiar with the meaning of each symbol, it is very easy to read them, and they can then be used correctly and quickly.

The make-up of the diagram would depend considerably upon the purpose for which it might be employed. A superintendent or station master, in making a study for rearranging station movements to secure greater capacity, would not need as large a diagram, nor possibly the same kind of a diagram, as would be needed by a towerman, or a train dispatcher, who must handle an emergency movement. It is possible that we might have a station used practically to its maximum capacity, and a certain train might come in late, or on some days there might be unexpected heavy excursion movements, and a diagram to fulfill this purpose should show at a glance at what time, on what track and by what route the different trains could be received. A towerman who has been working for any length of time in a certain tower would probably not have occasion to refer very frequently to this diagram, but a new man would use it constantly, until he became thoroughly steeped in the knowledge of the facilities which he has to handle.

The Belgian diagram gives a very complete picture at a glance, and concentrates on one chart all fouling points and tracks so that the whole situation is shown on the same sheet. It is complete in its representation; it can be spread out if the number of train movements are large, and after a knowledge is had of the fundamental principles it is very simple and can be read without hesitation. It is most important, however, to secure full value of the diagram, that we make a careful selection of the running lines and the numbers representing routes and fouling points.

Diagrammatical Method of Showing Actual Occupation and Working Capacity of Station and Throat Tracks, Broad Street Station, Philadelphia, Pennsylvania Railroad.

For a number of years past, it has been apparent that the track layout of the station and approaches at Broad Street station, Philadelphia, is seriously congested by the train movement incident to handling the service of that terminal. This condition is most in evidence during the rush hours, or peak load periods of the morning and evening, at which time any interference with the normal movement of traffic, such as occurs during severe weather, results in disorganization of the service and consequent delays to trains, from which recovery is slow.

The need for additional relief led to the appointment about two years ago of a board of engineers to study the whole situation, and prepare plans and submit a report for additional facilities. In considering the problem, the committee's first thought was to devise some means of showing graphically the conditions actually existing at the station and on the track approaches, during the peak load periods, or hours of maximum train service; the train movements handled during such hours requiring the maximum demand on the facilities provided. It was necessary that these diagrammatic studies, to be of practical service, should be of such a nature that the results obtained through any change in operating methods could be clearly indicated on the original charts. The charts fully met expectations, and were indispensable in studying the overcrowded condition of the terminal and the resulting changes that would ensue from electrification.

An analysis of the station and throat track layout developed the fact that there are six route or throat tracks at 18th street connecting the eight elevated approach tracks to the sixteen station tracks, over which all passenger train movements are made. A movement over any given route will, of course, block such route for other movements from the moment the route through the interlocking is set up until the movement in question clears the fouling point. It is also evident that when such a movement involves the use of switches which are necessary to the movement of train units over one or more of the five remaining routes, the routes so fouled are blocked until the movement in question clears.

It was apparent from these facts that with the proper data at hand, graphical charts could be prepared that would show all movements actually made over the throat tracks, including blockade of routes, and would indicate the extent to which these facilities were used. This method was, therefore, adopted and the necessary data obtained.

In preparing the throat track charts, the six routes were plotted as adjacent parallel spaces of convenient width and length, on which time was indicated by perpendicular lines. Each individual movement made over the different routes was plotted as a solid line rectangle, cross-hatched with solid lines to show the direction of movement and covering the time included between the actual setting up of the route and its clearance by the movement in question. The blocking of routes other than the one actually in use by any given movement was shown by rectangles, cross-hatched with dotted lines. The character of each train unit handled was indicated on the charts, and, where blockades of other routes resulted, the actual movement made was shown.

The station track diagram showed by means of rectangles, the equipment properly designated, occupying the different station tracks during the busy hours, and the time of arrival or departure of each train unit. The width of track spaces and train diagrams were drawn to scale, and the relative amount of track room occupied by each train unit was, therefore, indicated.

Examination of these diagrams or charts indicated very clearly the congestion now existing, and showed conclusively that the tightest place was at the throat of the station, and that the six routes in their capacity for handling movements were not evenly balanced. This condition is due to the character of the track layout.

These different charts are well adapted to the study of the results to be obtained from electrification; the elimination of shifting movements that would follow the use of multiple-unit electric traction for certain groups of trains being readily indicated on the original diagrams.

The re-plotting of trains can be done without introducing unknown factors, as it is only necessary to adhere to the figures obtained in actual practice, as given in the tower records and plotted on the original diagrams. If new trains are to be introduced, a glance at the station chart will show what platforms are available at any particular time, and, by referring to the throat track chart, one can easily ascertain whether the movement can be made at the desired time without interference with existing conditions.

The daily number of scheduled trains when the tower record was taken in January, 1912, was 543; the number of scheduled trains in the busy two-hour period from 4:00 to 6:00 p. m. was 78, and 286 movements were made in both directions past "A" tower in the same period.

In addition to suburban and long distance passenger trains, a large amount of baggage, mail and express must be cared for. The handling of theatrical scenery and some full carload lots for periodicals is undertaken at West Philadelphia.

Graphical Diagram Devised by Committee for Use in Analyzing Working Capacity of Passenger Stations.

The purpose of the graphical diagram showing the working capacity of a passenger station is twofold: To make clear the necessity for changes in design in the way of revision of or additions to the track layout, and to lay out a working time card.

It is desirable to be able to see at a glance for each station track relatively for any instant: The capacity and the space yet available, the make-up and the amount of equipment occupying, the scheduled time of arrival and departure of such equipment, the switching movement required on any connecting internal crossover and the route arriving and departing, and the direction of the movement.

The diagram should show clearly what throat tracks directly serve the various station tracks without interference with other routes, also, similar information as between the throat tracks, and the different main or running tracks outside of the station; the arbitrary time consumed by a movement over a throat track from the time the route is set up until it is cleared, whether the movement is a scheduled train, draft road engine or a switch engine, the route used before a movement enters a throat track and after it leaves, the direction of the movement and any interference from cross movements.

The method of graphic analysis designed for the committee contemplates satisfying each of these requisites. It has been applied on the diagram presented by the committee to the Broad Street (Philadelphia) station, for which data was available covering approximately 150 movements that are regularly made in the two-hour interval, 8:00 a. m. to 10:00 a. m. Such heavily congested traffic was selected so as to thoroughly test the method.

On the diagram heavy lines plotted as coordinates represented, respectively, the abscissa or horizontal lines the station track, the ordinate or vertical line the throat track, and a second abscissa the main running track. A line

was provided for each unit in these three classes of tracks A scale representing hours and minutes was plotted on each of these lines. For clearness, no less than 1-20 in. should be allowed for each minute.

The capacity of each station track may be shown by a number placed against the station track line to show its length in cars. Each station track line was also marked to show the number of track which it represents. The amount of space available on any track at any instant is the difference between the number of cars shown in any movement or movements occupying the track, and the total capacity of the track. Each occupying movement was shown by a relatively thin line paralleling and alongside of the station track line, and marked as to the character and make-up, both in cars and engines. The time of arrival and departure of any movement was shown by the minute on the scale at which the movement line, now extending vertically, crossed the track line. The heavy horizontal scale lines representing the station tracks jointly served by any certain throat tracks were assembled in a parallel group. The switching movements required on any internal crossover connecting with station track may be shown by drawing thin movement lines from the proper point, as to scale, on the occupation line on one track, through the proper point on the scale of the track to which the crossover connects, paralleling the latter during the time of occupation, and returning vertically again to the original occupation line on the first track. The route arriving and departing for any movement was shown in order by the figures and letters plotted on each movement line near the point of origin or ending on the station tracks, and denoted the respective station tracks, throat tracks and running tracks occupied. The direction of the movement is shown by an arrow.

The relative position of the vertical lines representing the throat tracks, and the horizontal lines, representing respectively the station tracks and the running tracks, showed the grouping as to direct connection one with the other. The arbitrary time consumed by a movement over a throat track from the time the route was set up until it was cleared was measured by the minimum space allowed between the crossing movement lines on the vertical scale line representing the throat tracks, and could also be shown by a number representing the minutes and placed at one end of the throat track line. The scales used should be no less than 1-20 in. to the minute for clearance sake. The vertical lines representing the throat tracks were respectively marked with the letters used to designate each throat track. The conventional movement lines, in addition to being designated at the points of origin and ending by figures and letters denoting as to whether they were trains, drafts, road engines or switch engines, and also as to the route used before a movement enters a throat track and after it leaves, could also be distinguished as to classification of movement, by the use of different colors, just as is customary in the use of strings or lines denoting on an ordinary railroad district time-card chart somewhat similar classification. The direction of a movement was given by the arrows at the points of origin and ending, and the interference of a movement on any throat track was shown by the fact that the movement line passed across each and every throat track line that might be blocked by the movement.

Should it be desired at any terminal to use this method in laying out a working time card, chart boards of a size sufficiently large to suit the purpose could be provided, on which could be permanently plotted the scale line conventions for the station tracks, throat tracks and running tracks. The movements would be indicated temporarily by lines of different colors and would be shown upon the chart by means of strings fastened by pins, as is done on the ordinary railroad district time chart. Tags properly marked and attached to the pins at the originating and terminating point of the movement would give the detail information required, so that after the movements are plotted to meet requirements of the proposed new time card, the information could be checked and called off in the customary way for making up the printed working list, showing arrival and departure of trains and tracks used for each. Should certain movements during any interval of time appear to create an undesirable congestion of traffic, a rearrangement of the strings on the chart may be studied and put into effect, and the possible interference brought about by any such change anticipated and avoided. Should one or more station tracks appear to be handling more than their share of the traffic, similar attention to the chart or diagram can be given, and if no other solution develops, the necessary slight changes in track connections may be made.

Where congested traffic demands, the working charts or diagrams need only be limited in size by the space on the wall available and within reach, and as a rule, where the traffic is as congested as in the Broad Street station, extra sets of charts may be required to satisfactorily cover the day's work. One possible good feature of this method is that it may be handled personally by transportation men, making use of the colored strings, and may be revised and rearranged by them quickly to suit any change in traffic conditions. The make-up of the trains may, if desired, be shown on the diagram also by conventions, representing arbitrarily each style of equipment, placed in order on a line at right angles with each station track scale line and against the time of arrival or departure, indicating the mail, express, baggage, coaches, dining cars, sleeping cars and parlor cars.

In General.

The committee recommends that for the design of a large passenger terminal there should be considered the situation plans submitted to the association in 1911, eliminating the notation 1-7 as applied to the angle of the ladder. These layouts would be expanded or multiplied in such a way as to best meet the requirements of the real estate owned at any particular location.

The committee also desires to emphasize the possibility of the substitution of inclines or ramps in place of stairways in busy stations. In all such stations where the track level is above or below street level, stairway connections have the objection of interrupting and checking the flow of travel at busy hours. This is especially the case where much suburban traffic is handled. It is of interest to note, therefore, that in the new Grand Central terminal at New York inclines have been adopted at several points, presumably because they were considered safer and more expeditious than stairways. The grade of these inclines seems to be eight per cent. Experiments have been made to determine the grade best adapted for convenience. In many places there is not space available for such inclines, but in designing new stations this feature might well be studied.

Conclusions:—In the design of a large passenger terminal the committee presents for adoption the following conclusions:

(1) A holding yard should be directly connected with the platform tracks to provide for a quick emptying and refilling of the latter.

(2) At passenger terminals, where large quantities of baggage and express must be handled, and it does not appear expedient to provide intermediate platforms to be used exclusively for this service, it is recommended that, where conditions permit, baggage and express be received, delivered and handled below or above the train floor (as grade conditions demand) and raised and lowered by elevators, conveniently located, to avoid interference with the movement of passengers.

(3) To provide for proper coupling of cars a maximum curvature for storage and loading tracks of six deg. is recommended.

(4) For safe, efficient and economical operation on station throat tracks the curvature through switches should not exceed that of a No. 8 slip on tangent.

The committee presents as a progress report, without recommendation as to relative merits, the three methods of graphical analysis of working capacity of a passenger station.

DESIGN AND OPERATION OF HUMP YARDS.

Circular letters were sent out during the year to a number of large railways, and as far as the committee was able to ascertain, the only large hump yards built during the last year were the Centralia, Ill., yard of the Illinois Central and the Godfrey, Ill., yard of the Chicago, Milwaukee & St. Paul. A small hump yard has been partially constructed by the Kentucky & Indiana Terminal railway near Louisville, Ky., but as some changes are to be made in plant, it will not be possible to make any report on the yard at this time. (The report then described the Centralia and Godfrey yards, which were described in the *Railway Age Gazette* of Aug. 9, 1912, and April 14, 1911.)

The committee feels that a careful study should be made of the operating conditions of all hump yards and results tabulated to see if improvements cannot be made in some of these yards to secure better efficiency.

Conclusions.

Where tracks are set aside for holding empty cars, the grade leading to such empty tracks should be increased so

that empty cars will move with the same velocity as loaded cars switched to adjoining tracks.

The committee has investigated the "Cut List" system of handling cars on the hump and recommends it as being safe and efficient. This system is briefly described as follows: The yard clerk makes up a list of cars to be switched and tracks they are to be placed on in receiving yard, cut No. 1 being the first car to go over the hump. Cut list form is perforated on three vertical lines, so the list may be divided up into four parts, each part being a duplicate of the other.

Where switches are thrown from a tower, one copy of the list is given to the towerman and one to the man cutting off cars on the hump. Where switches are thrown by hand, each

Cut List			Cut List		Cut List		Cut List	
No. of Cut	No. of Track	Cars in Cut	No. of Track	Cars in Cut	No. of Track	Cars in Cut	No. of Track	Cars in Cut
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
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Cut List for Switching in Hump Yards.

switch tender has a copy of the cut list, as well as the man cutting off cars on the hump.

DEVELOPMENT IN THE HANDLING OF FREIGHT BY MECHANICAL MEANS.

During the past year the committee has made considerable study of the mechanical handling of freight, especially as to the work carried on at the freight house of the Missouri, Kansas & Texas at St. Louis; the Baltimore & Ohio, Pier No. 8, Locust Point, Baltimore, Md.; the Wabash Pittsburgh Terminal freight house at Pittsburgh, Pa. It has also made further study of the use of electric trucks and other appliances.

Commenting on the M. K. & T. freight house, which was described in the *Railway Age Gazette* of June 23, 1911, the committee reports as follows: The daily duty required at this station is approximately as follows:

(1) To handle one million pounds of outbound freight per day for loading into 77 cars.

(2) To handle a considerably less amount of inbound freight, the outbound freight being mostly handled in the afternoon and the inbound freight mostly handled in the morning.

The cost of maintenance of the telpherage system is considerable. In this particular case, however, it was due to the first installation of the overhead rail being soft, necessitating its renewal with a harder grade of steel. Along with the rapid wear of the rail originally installed it was noticed there was more or less injury to the eyes of the employes on account of fine particles being ground off the rail and falling through the air. It has further been found that considerable damage to freight is likely to result—more than results from the ordinary handling of freight, due to crushing by heavy loading on the trucks and on account of the motorman dropping loads with too great force. It has been found in practice that the trucks cannot generally be loaded to their full capacity without frequent rehandling, which is impracticable on account of not sufficient freight destined to a particular car being assembled for loading in its immediate vicinity.

There has been greater difficulty in preventing freight going astray as the result of two sets of men handling the freight on the two floor levels and no check between them. It is further impracticable to avoid a great many empty runs with the telphers to bring back empty trucks, by reason of the fact that when a loaded truck is deposited through a hatchway no empty truck can be placed at the same point to be picked up at that time, and the telpher has to return later to pick up the empty truck from that same hatchway. There is a hazard of personal injury to truckers compelled to work under the trucks while being conveyed, due to the liability of packages falling therefrom. It has developed that there is likely to be considerable idle time of employes, resulting from difficulty in so distributing the freight as to have trucks at all times at the several cars ready for unloading as soon as the trucks previously delivered have been emptied. There is more supervision required to check against idleness and also against pilferage. A repair force at considerable expense is required for the maintenance of the electrical equipment, even at the present time, when the installation is comparatively new, and the cost of maintenance is expected to increase in considerable measure as the equipment becomes older and more worn. The manual labor required in the handling of freight has been demonstrated by experience to be necessarily about as great as the handling of freight on one level without any intermediate mechanical handling, as the result of which the cost of handling freight by this system is materially, and apparently unavoidably, increased, rather than decreased.

It is probably true that the design of the building and of the telpher equipment could be improved, involving less first cost and less maintenance cost. It is naturally to be expected that this would be the case on account of this undertaking being entirely novel as applied to the handling of less-than-carload freight. While the working of this plant seems to indicate that the practicability of handling less-than-carload freight is questionable, there is no question but that the use of the telpher for any certain commodity can be successfully and economically worked where elevation and distance are factors to be considered, or where, regardless of classification, freight is to be delivered at a common point, as for the loading of a vessel. This is further borne out by the fact that a successful telpher system is in use by the Baltimore & Ohio Railroad on its Pier No. 8, Locust Point, Baltimore, Md., where miscellaneous freight is transferred from cars to vessels.

It was expected that the capacity of this St. Louis freight house, with its equipment, would be greatly in excess of the present demand for handling freight, or at least could be made capable of handling a greatly increased amount of freight simply by the addition of telphers and men. But it has been demonstrated by experience that the present volume of traffic about measures the capacity of this plant for handling classified freight, which is a disappointment.

The Missouri, Kansas & Texas was forced to quick action in the nature of providing facilities and was limited as to space in order to obtain desirable location. It is to be complimented for making the bold experiment at a very heavy cost of installation, and it is to be hoped that it may yet find a way of attaining economy in its operation.

Electric Trucks.

Four-wheeled platform motor trucks have been introduced in a number of cases to replace the ordinary two-wheel trucks,

the former having greater carrying capacity and higher speed than the latter. The truck system has the advantage of flexibility of movement with no fixed routes, as where carrier or telpher systems are used, and no investment for fixed plant, while it may be tried and introduced in existing freight houses without trouble.

The Delaware, Lackawanna & Western Railroad is using several storage battery one-ton trucks of this kind (Sprague and General Electric systems) at its transfer station at Secaucus, N. J., where freight brought in cars from various collecting stations in New York is transferred to cars for the outbound local and through trains. The transfer station has two pairs of tracks for the transfer cars, two for local cars, and two for through cars, these being separated by three platforms 900 ft. long (23 cars) and about 22 ft. wide. The trucks are 72x44 in., with the floor 22 in. above the rail and a motorman's platform at one end with controller, brake and steering gear. They have electric bells to warn the truckers and other men, and can move at a speed as fast as ten miles per hour. The trucks are run directly into the cars, over steel bridge plates placed at the doors, and in this way pass to cars on the second track from the platform. Current is supplied from a line supplying the yards and is converted to the necessary voltage by a small plant on one of the platforms. This transfer house with electric truck service is described in further detail in the Engineering Record of September 21, 1912.

Abstracts of papers presented before the New England Railroad Club on February 13, 1913, were also given. (See Railway Age Gazette, November 8, 1912.)

Another type of storage battery truck, built by the Cleveland-Galion Motor Truck Company, has been used experimentally in the freight station of the Lake Shore & Michigan Southern Railway, at Cleveland, Ohio. This is described in the Railway Age Gazette, October 11, 1912.

In addition to the above, we find some roads and steamship companies are using inclined elevators, overhead jib cranes, stacking or elevating conveyors, briefly described as follows:

Inclined Elevators.

There is a somewhat extensive use of inclined elevators at piers to assist the moving of loaded hand trucks on the inclines between ships' decks and the pier floor. Some of these are traveling platforms, which carry the men and the trucks. Others are simply endless chains which have lugs to engage the axles of the trucks and push them forward, the men walking the ordinary way. The Otis Elevator Company has built a number of installations of the latter class and some of the former class (all on the Reno patents). The installations of the chain type include piers of the Boston & Maine at Boston; the New York, New Haven & Hartford at Bridgeport, Conn.; the Merchants' & Miners' Transportation Company at Savannah, Ga., and the Metropolitan Steamship Company at Boston. Each of these has two electrically operated machines, except that the last has three machines. It is stated that the last named company estimates a saving of $33,000 in handling its freight for one year, which is approximately six times the cost of the machines. Each machine can handle from 600 to 1,900 trucks per hour, according to the speed of the chain.

Overhead Jib Cranes.

A type of crane which is used extensively in freight houses in Great Britain is a combined traveling and revolving overhead crane. Instead of the usual hoisting trolley on the bridge of the crane, the trolley has suspended from it a frame which carries a horizontal boom or jib, and this frame can be revolved through a complete circle. The freight house of the Great Western Railway at Cardiff, Wales, has a Babcock & Wilcox electric crane of this type; its bridge has a span of 50 ft., and the boom on the traveling trolley has a working radius of 18 ft. The hoisting capacity is one ton, and the speeds are as follows:

Bridge travel.....250 ft. per minute
Trolley travel.....120 ft. per minute
Swinging .....230 ft. per minute (at end of boom)
Hoisting ..... 30 ft. per minute

The new freight station of the North British Railway at Glasgow, Scotland, has 15 overhead traveling cranes for unloading cars. These are of the revolving jib type mentioned above, the jib being 23 ft. long, but the trolleys run on narrow parallel runways instead of upon a traveling bridge. Two of these are three tons and the other 1½ tons hoisting capacity. Each of the latter has a 17 h. p. motor for hoisting at 100 ft. per minute, one of 2 h. p. for swinging at two-thirds of a revolution per minute, and one of 4½ h. p. for traveling at 360 ft. per minute. For hoisting freight from cars to the upper floors of the warehouse, there are two traveling trolley hoists on each floor, with three wells or shafts for interior hoisting, while the top floor has a 1½-ton trolley carrier or helper. There are also six elevators at one side of the house. For handling heavy freight, there is a gantry crane, having one end of the bridge supported by a leg with wheels riding on a rail laid on the ground level, while the other end is carried by wheels on a runway built on the freight-house wall. The bridge is of 50-foot span, and carries a traveling hoist of 40 tons capacity. The bridge has a travel of 200 ft. along the front of the freight house and into the yard.

Stacking or Elevating Conveyors.

In pier sheds, cotton sheds, storage warehouses, etc., it is often desirable to stack goods (in bales, sacks, boxes, etc.) to a considerable height, in order to save floor space. Sometimes an overhead traveling crane, or traveling bridge with hoisting trolley, may be installed for this purpose. In many cases, however, a portable machine would have a greater range of usefulness, and several portable elevating and conveying machines of this kind have been installed by the Brown Portable Elevator Company. These installations include the stacking of grain and sugar in sacks, stacking hay in bales, and also handling miscellaneous materials and freight. One installation is for the Central Railroad of Georgia, at Savannah, Ga., for piling bags of material on a pier. The conveyor is carried on a steel frame mounted on a wheeled truck, on which is mounted also the motor and driving mechanism, and this frame can be adjusted to any desired inclination and height. In some machines there is a separate carrier on each side of the truck, so that one may be inclined to raise material from the floor to the heel of the other conveyor, this latter being adjusted to a horizontal or inclined position, according to the point to be reached.

Some freight handling installations at piers have been mentioned above, but in crane equipment for handling ship cargo American ports are notably behind European ports. At the former, reliance is placed mainly on the ship's winches and cargo booms, which can handle material only directly alongside. In European practice there are usually numerous traveling cranes along the quays and sheds. The tower type of crane is a jib crane on a tower mounted on wheels to run on tracks along the piers or docks. The portable type of crane is mounted on a steel tower traveling on a track of wider gage than that of a railway track, and made open so that cars can run beneath the crane, and the crane can move from point to point, without interfering with car on the track which it straddles. A semi-portal or semi-gantry crane may span the width of quay between the freight house and water; the outer end of the bridge is supported by a leg traveling on a rail near the edge of the quay, while the inner end is carried by wheels riding on an elevated runway on the freight house, like a traveling crane. On the tower or bridge is a revolving jib crane, which may be fixed in position or may traverse along the bridge. In many modern installations, the cranes travel on the roof of the pier or warehouse, so that they handle cargo between ship, car or warehouse without obstructions to the tracks or driveways between the house and the ships.

The rail and water terminals at Texas City, Tex., on the mainland side of Galveston Bay were described in the Railway Age Gazette of July 12, 1912. The main pier is 1,400 ft. long and 1,000 ft. wide, with four parallel warehouses: 80x1,120 ft., 118x520 ft., and two 100x750 ft. On shore there are four warehouses in line: One 75x1,000 ft. and three 100x250 ft. One warehouse is equipped with three overhead traveling cranes and an electric conveyor along the floor extending the full length of the building. On one side of the dock are two traveling gantry cranes about 120 ft. long, with hoisting trolleys on the bridge. The inner end of the bridge extends over the warehouse roof, the alternate panels of which are removable so as to form hatchways. The outer end of the bridge projects beyond the dock line, so that freight can be handled directly between the ship's hold and the warehouse.

C. H. Spencer, Chairman; E. B. Temple, Vice-Chairman; W. G. Arn, Hadley Baldwin, W. C. Barrett, G. H. Burgess, A. E. Clift, H. T. Douglas, Jr., A. C. Everham, Geo. P. Johnson, D. B. Johnston, H. A. Lane, L. J. McIntyre, B. H. Mann, A. Montzheimer, W. L. Seddon, E. E. R. Tratman, W. L. Webb, J. G. Wishart, Committee.

Discussion on Yards and Terminals.

Mr. Fritch: I would like to know what the committee means by "holding yard" in the first conclusion under the heading "In General."

B. H. Mann (M. P.): A reservoir yard, you might say, for empty equipment in advance of placing the cut at the station platform.

Mr. Fritch: I believe "storage yard" is a preferable term.

Mr. Mann: "Storage yard" does not correctly represent the meaning of the committee. A storage yard may be a yard in which the empty equipment is placed after the receipt of the train. The wording here is intended to cover the condition where, as the equipment comes from the storage yard, it comes up to the mouth of the station, so as to have that draft, all ready to be pushed into the station just as soon as the track is empty. "Storage yard" has a broader meaning. The "holding yard" has a more limited and a narrower meaning.

Mr. Spencer: The committee wish to change conclusion 2 on page 401 of the Manual, to read as conclusion 2 in the report.

William McNab (Grand Trunk): It seems to me the recommendations would read better if we reverse the wording slightly: "It is recommended that, wherever conditions demand, baggage and express be received, delivered and handled, below or above the train floor (as grade conditions permit)," etc.

The President: The committee will accept that.

Hunter McDonald (N. C. & St. L.): There seems to be some question about the wording regarding the receiving of baggage and express. In most cases that must be done at grade and then the baggage and express is lowered or elevated to platforms. You receive it and deliver it at grade, but you lower it in order to deliver it to the trains or elevate it in order to deliver it to the trains.

Mr. Spencer: I presume in the larger number of smaller stations that may be true. In a large number of our stations, however, baggage is received below the grade. For instance, in Washington, the baggage is received below the grade and elevated to the train floors by means of elevators. In the New York Pennsylvania station the baggage is received above and is lowered. It is to meet these varying conditions and to bring out the best arrangement possible for handling baggage with the least interference with the movement of passengers that the committee made this conclusion.

C. E. Lindsay (N. Y. C. & H. R.): I move the omission of the word "safe" in conclusion 4. (The motion was seconded.)

Mr. Spencer: The committee rather objects to the omission of the word "safe." We had a great deal of discussion in the committee meeting as to entering into questions of safety, but we have taken this position; the Eastern roads, and I think it is spreading out into the West, are putting the question of safety first. I think that is illustrated by the New Year's address sent out by President Willard to the employes of the Baltimore & Ohio Railroad. The time has come when this department has got to enter into questions of safety, and I believe it is the province of every committee to enter into these questions and to recommend what appears to it to be the safe and efficient method. In regard to "No. 8 slip switch on a tangent," a great deal of the trouble experienced in curves is in switches, and it has been found by experience that the curvature through a No. 8 slip switch, although that varies on the different roads, is about the maximum of what should be used.

L. C. Fritch: I think the word "safe" is unfortunate in that connection. By adopting that we practically say that anything greater than that, or, say, a No. 7 or No. 6 slip switch, is unsafe. We have many installations in this country that have a curvature where it exceeds that of a No. 8, and to make the change would involve very large expenditures. The operation through them, if it is conducted properly, is just as safe as it is through a No. 8.

The President: Your idea is that safety can be secured by proper control of the speed?

C. E. Lindsay: A road that adopts a No. 8 turnout for its equipment may be entirely justified, whereas another road, with other equipment, may be entirely justified in using a frog as low as No. 6. We have just about completed the Grand Central Terminal, in which 6½ frogs are used. We think it is perfectly safe under the operating conditions and the equipment that we have.

S. S. Roberts (I. C.): I agree with the committee in regard to the statement of the curvature. To my mind, it is a warning against placing a slip switch on a curve. Very frequently, if you say the curvature shall not be greater than the curvature of a No. 8 slip switch, some man may thoughtlessly place a slip switch so that part of it will be on the inside of a curve, and then he increases the degree of curve in the slip. This statement conveys to me the idea that the curvature in a No. 6 switch upon a tangent is the maximum curvature that you desire to use. If this slip switch were placed on a curve some other number would have to be used in order to attain the degree of curve you would want.

The President: The committee will accept the proposition to remove the word "safe" in that paragraph.

C. Dougherty (C. N. O. & T. P.): In connection with this it seems to me the proper design of connections with slip switches in terminal stations involves so many surrounding conditions, such as the class of engines used or equipment, the speed with which trains are expected to move over the switches and the cost of providing rights of way sufficient to put in frogs of a lower number, that it makes it impossible for this association to adopt a general statement in regard to such matters.

Mr. Lindsay: On our road we have had a great many derailments of a certain type of locomotive on No. 7 slips and turnouts. The No. 7 slip is in general use, but we have had so many derailments of engines supposed to be designed for use around No. 7 slips, it came to be a question whether we would have to throw away the engines or rebuild the slips. We secured the co-operation of the motive power department and tested out those engines, and we have shown to that department the error in the design of the locomotives. They have corrected it, and made it perfectly possible for that engine, a big one, to go around those slips without any danger of derailment. I believe firmly it is perfectly desirable to limit the No. 8 where it is possible to do so, but to say it must be done is going too far.

J. L. Campbell: There may be a question as to the interpretation of the words "efficient and economical." I suppose the committee had in mind the things involved only in running the train around those curves. However, if all of the elements are taken into consideration the substitution of sharper curves in some cases cited might show that it will not be either efficient or economical to do that. I would ask the committee to modify that to read as follows: "Where practicable on station throat tracks the curvature through switches should not exceed that of a No. 8 slip on tangents."

The President: The committee will accept that.

Mr. Spencer: Mr. President, I move the adoption and insertion in the Manual of the 4 conclusions as modified. (The motion was seconded and carried.)

Conclusions under Hump Yards were next considered.

Mr. Spencer: We wish to change conclusion No. 2 from the way that it reads now to read as follows: "The cut list system of handling cars on the hump is recommended as being safe and efficient and is briefly described as follows: 'The yard clerk makes up a list of cars to be switched and tracks they are to be placed on in receiving yard, cut No. 1 being the first car to go over the hump. Cut list form accompanies this report. It is perforated on three vertical lines, so the list may be divided up into four parts, each part being a duplicate of the other. Where switches are thrown from a tower, one copy of the list is given to the towerman and one to the man cutting off cars on the hump. Where switches are thrown by hand, each switch tender has a copy of the cut list, as well as the man cutting off cars on the hump.'"

G. W. Kittredge (N. Y. C. & H. R.): I would like to ask if it is necessary to put the word "safe" in that second conclusion? It carries with it the insinuation that any other process is unsafe.

Mr. Spencer: Not necessarily so. The committee visited a number of hump yards this year. We saw several methods of marking the cars going over the hump. We did not mention the ones that we felt were decidedly unsafe. We saw men running in front of cars chalking on the ends. We saw men running along the side of the cars, taking hold of the grab iron, reaching around the ends and putting figures on the end. This cut list system is in use on the Pennsylvania Railroad. In the work of marking up the cars as done with this list there is no occasion for a man to get injured in any way in giving information to the towerman or to the switchman as to where those cars should go.

S. S. Roberts: The use or the lack of use of this cut list will have some effect on the design of the yard. If you adopt the method of marking on the ends of cars to meet the classification track on which the cars go, it necessitates a very much more complete and much more careful design on the hump than if you adopt this list, because it is necessary then, if the switch is thrown by hand, and to the towerman, if the switch is operated by power, to see the numbers on the cars by night as well as by day, so they can properly set the switches. A good many yards have had difficulty, and some roads have spent a good deal of money because they do not use a switch list. I think the word "safety" in this list is entirely proper. I have visited a number of yards, operated in different ways, and I have seen men dancing around moving cars, putting numbers on the ends of those cars. I would not consider such a job as that for five minutes, no matter what they pay for it. I think safety is entirely proper in this association. An-

other thing, about the lighting, if you have sufficient light on your hump to indicate the number of the car to the towerman or to the switchman, you have got so much light that your car riders are almost blinded, and they get off away down the yard before their eyes become accustomed to the darkness, and you are apt to have more trouble on account of the cars coming together.

Mr. Mann: Just for information, it was the thought of the committee as well that the cut list is a splendid help in O. S. & D. work. The man who handles the cut list keeps a record of the rider, and if there is any damage to the car or the freight in the car, it can be directly traceable to one individual, the rider, provided we file away the cut list. It is a splendid help in the operation of the yard in keeping down damages.

G. D. Brooke (B. & O.): I would inquire from the committee if they consider that these methods which they state were unsafe were efficient? It seems to me that the word "efficient" covers the matter of safety well enough; but a method of operation which is inherently unsafe is at the same time inefficient, and I will be very glad to see the word "safe" omitted.

The President: The committee will accept that amendment. It is also understood that the word "efficient" takes the place of "safe."

Mr. Spencer: The recommendation No. 2 now reads:

"The committee has investigated the 'cut list' system of handling cars on the hump and recommends it as being efficient, and the system is briefly described as follows:

"The yard clerk makes up a list of cars to be switched and tracks they are to be placed on in receiving yard, cut No. 1 being the first car to go over the hump. Cut list 4 accompanies this report. It is perforated on vertical lines, so that it may be divided into multiple parts, each part being a duplicate of the other. Where switches are thrown from a tower, one copy of the list is given to the towerman and one to the man cutting off cars on the hump. Where switches are thrown by hand, each switch tender has a copy of the cut list, as well as the man cutting off the cars on the hump."

The President: Unless there is objection, these two recommendations are approved.

W. I. Trench (B. & O.): I believe, in addition to giving this information to the four persons listed here, that the car rider should also have the information, and this can only be given efficiently by chalking on the ends of the first car or cut. If the car rider does not know on which track his car is going he has no means of determining just what amount of breaking should be done.

Mr. Mann: This matter is subject a good deal to the state of the weather. The yard has to be operated in a pouring rain and the design of the yard is such that the car moves at a certain speed from the top of the hump to the end of the ladder, and after it reaches the ladder it is designed, presumably, to be at such speed that the rider has the cars under control. Each track is presumably marked by a light on the first car so that the rider has all the information necessary without this, and it would be a serious handicap to hold the rider responsible for anything which you would give him on a sheet of paper, bearing in mind that he is out in a good hard rain.

Mr. Trench: I did not refer to giving the information on a sheet of paper. The method which I have seen used successfully is to mark on the first car of the cut "five cars, track 18," or some such notation as that. It is not possible for the man who is cutting off the cut to give the car rider this information, because he is on the opposite end of the cut. I believe it to be true that it is necessary for the car rider to apply the brakes because we see it done on almost every cut. If it is necessary, to avoid a collision, to apply the brakes at the first end of the track into which he is entering, he should have this information.

Mr. Spencer: There is no end to the extent to which this cut list might be carried. It is a matter of how the different roads may want to operate it. There is no objection giving the car rider one of these lists or anyone else who might have use for it. We have provided in our recommendation, as last presented, a multiple cut list which would furnish sufficient copies to extend the system as far as it is desired.

Mr. Roberts: In watching the operation in the use of the cut list, it seems to me entirely necessary to mark on the car where the cut is going to. The foreman tells the rider where to take the cars—he says, for instance, "Take five cars to track No. 4." That is all the information the rider needs, and he should have memory enough to know to what track he is going while he rides through the yard.

Mr. Spencer: I move the adoption of the conclusion as revised. (The motion was carried.)

Mr. Spencer: The last subject assigned to the committee is entitled "Development in the mechanical handling of freight by mechanical means." We present a further report on this subject for information only.

The President: The committee has presented a very complete and enlightened report that will be useful in all branches of railroad work, relating to the operation of yards and passenger stations. The committee is relieved, with the thanks of this convention.

ELECTRICITY.

CLEARANCES.

The committee submits the following report as one of progress and information. It has considered a communication calling attention to interference with the bridge clearance line of the association by the recently adopted third rail, permanent way structures and rolling equipment clearance lines, and has made a recommendation to the committee on Iron and Steel Structures that as much of the bridge clearance diagram as interferes with the third rail and permanent way structures clearance line be eliminated, and in place thereof the clearance line for permanent way structures be substituted on roads where electric equipment is likely to be used.

GEORGE W. KITTREDGE,
Chairman Committee on Electricity.

The committee on heavy electric traction of the American Electric Railway Association submitted a report at the annual meeting held at Chicago in October, 1912, which report recommended clearance lines for third rail, permanent way structures and rolling equipment identical with the lines adopted by this Association at its last meeting, and also submitted for information and guidance a suggested clearance diagram for automatic stops, with the recommendation that the matter be continued to allow the committee time to confer with similar committees of this Association and the American Railway Association. The American Railway Association at its meeting in May, 1912, adopted a clearance diagram for third rail, permanent way structures and rolling equipment identical with the diagram adopted by this Association.

The committee has been following up the progress made during the year on third rail installation and has had the table which accompanied last year's report brought up to date. It is urged on the members of this Association that they try and induce their companies to conform to the clearance diagram on all new work and gradually change over their present installation so that ultimately there can be a free interchange of electric equipment between the various roads.

The committee has been collecting data during the year in regard to overhead clearances and is studying same with a view of taking up this question during the coming year with committees of the American Electric Railway Association and the American Railway Association, so that joint recommendations for overhead clearance lines may be made by the respective committees of each Association.

DATA REGARDING THIRD RAIL CLEARANCES. Revised January 15, 1913.

Name of Company	Plan No.	Top or Under Contact	Protected	Uses Steam Equipment	Structures Clear Prop. Lines	Mileage in Operation	Mileage Planned for Immed. Future	Mileage Using Steam Equipment	Mileage Clearing Proposed Lines	Remarks
Albany Southern	1	Top	No	Yes	Yes	65.00	.....	65.00	65.00	.....
Aurora, Elgin and Chicago	2	Top	No	Yes	No	95.00	.....	95.00	.....	7.70 Miles O. H. Trolley.
Baltimore & Ohio	3	Top	Yes	Yes	Slight	8.70	.....	8.70	8.70	.....
Boston Elevated Ry	4	Top	No	No	No	33.81	.....	.....	.....	.....
Brooklyn Rapid Transit	5	Top	No	No	No	87.99	.....	.....	.....	49.83 Miles O. H. Trolley.
Northwestern Elevated, Chicago	6	Top	No	No	No	60.00	.....	10.00	.....	16 Miles O. H. Sliding Contact.
Central California Traction	7	Under	Yes	Yes	Yes	70.00	.....	70.00	70.00	27 Mi. O. H. Trolley, inc. in 70 Miles.
G. R., G. H. & M.	8	Top	No	No	No	31.26	.....	.....	.....	10 Miles O. H. Trolley-Urban.
Hudson & Manhattan	9	Top	Yes	No	No	18.76	.....	.....	.....	Subway.
Interborough Rapid Transit	10, 11, 12	Top	Partly	No	No	203.36	.....	.....	.....	Elevated 118.0. Subway 85.36.
Lackawanna & Wyoming Valley	14	Top	No	Yes	No	44.00	.....	44.00	.....	5 Miles O. H. Trolley.
Long Island R. R.	13, 18	Top	Yes	Yes	Yes	186.80	18.20	186.20	186.20	.....
Metropolitan West Side, Chicago	6	Top	No	No	No	51.08	.....	.....	.....	Elevated.
Michigan United	16	Top	No	Yes	No	107.00	.....	107.00	.....	.....
Nor. Electric Ry., Chico, Cal.	17	Top	No	Yes	No	130.00	42.00	130.00	.....	18.79 Mi. O. H. Trolley & Pantograph.
P. R. R., Manhattan Division	18	Top	Yes	Yes	Yes	70.93	.....	70.93	70.93	1.63 Mi. O. H. Contact included in total.
Puget Sound Electric Ry	19	Top	No	Yes	No	37.50	.....	37.50	.....	10.0 Mi. O. H. Trolley-Urban.
Philadelphia & Western	20	Under	Yes	Yes	No	34.00	.....	34.00	.....	1.50 Mi. Trolley in Yards.
Scioto Valley Traction Co.	21	Top	No	Yes	Yes	66.50	.....	66.50	.....	3.86 Mi. Trolley-Urban.
P. R. R., New York Division	.....	Top	Yes	Yes	Yes	27.45	.....	27.45	27.45	.....
South Side Elevated, Chicago	6	Top	No	No	No	46.41	.....	.....	.....	0.6 Mi. at Yard Leads.
P. R. R., West Jersey & Sea Shore.	23	Top	Yes	Yes	Yes	150.26	.....	150.26	150.26	8.65 Mi. O. H. Trolley included in total.
Wilkesbarre & Hazelton	24	Top	Yes	Yes	Slight	29.50	.....	29.50	.....	1.50 Mi. O. H. Trolley.
N. Y. C. & H. R.	26	Under	Yes	Yes	Yes	185.89	52.70	185.89	185.89	1.6 Mi. O. H. Conductors.
Detroit River Tunnel Co.	26	Under	Yes	Yes	Yes	19.27	.....	19.27	19.27	New station will require add 3rd Rail.
Phila. Rapid Transit Co.	.....	Under	Yes	No	No	18.61	.....	.....	.....	Subway & Elevated Lines.
Oneida Railway Co.	25	Under	Yes	Yes	Yes	103.47	.....	96.23	103.47	8.95 Mi. O. H. Trolley.
						1982.55	112.90	1433.43	887.17	

Summary of Data Regarding Third Rail Location.

The committee is not prepared at this time to take up the question of clearance lines for automatic stops, but as soon as a device that is adapted to conditions obtaining on roads operated in the open has been perfected, the question of established clearance lines will be further considered.

TRANSMISSION LINES AND CROSSINGS.

The committee desires to report progress on the consideration of modifications of the specifications for overhead crossings of electric light and power lines adopted by the Association at the last convention for Transmission Lines and Crossings as will be necessary to cover voltages over 70,000 and also the consideration of the revision of the specifications in paragraphs Nos. 10, 13, 18, 24, 29, 31, 32, 34, 45, 49 51, 55, 60 and 61, which were adopted by the Association with the understanding that the revision of these particular paragraphs would be considered this year. The committee, however, is not prepared at this time to make any further recommendations for the reason that more time is required to study the development of the art in respect to voltages over 70,000, and further because of the fact that the committees of all the various engineering associations have not as yet arrived at an acceptable joint specification.

ELECTROLYSIS.

An invitation has been received from the American Electric Railway Association to unite with them in jointly considering the subject of "Electrolysis," and the chairman has appointed Messrs. Katte, Gibbs and Brumley to serve on this joint committee.

The committee submits the following report with recommendations that it be printed in the Proceedings of the Association as information.

Introduction.—The effect of electrolysis upon steel and iron structures, including water, gas and electric conduit pipes, also on the lead sheaths of insulated cables, has been a matter of serious concern ever since the first street car was operated electrically by means of a grounded return, but not until the advent of electrification on steam railroads did the subject become one of much interest to railway engineers. The matter is receiving the careful consideration of electrical engineers in conference with structural engineers and representatives of various municipal departments, but up to the present time there is no unanimity of opinion as to the best methods of preventing electrolysis, or for protecting metal structures adjacent to the path of grounded return circuits.

Nature.—Electrolysis as referred to in the Electric Railway discussions may be described as the wasting away of corrosion of a metal which is caused by an electric current passing from one metallic conductor to another conductor where both are buried in damp earth, or other semi-conducting medium.

Causes and Effect.—In direct current railway circuits the electric current passes from the power station or substation to the trolley wire or third rail, then through the motors of electric cars or locomotives and back to the station by the track rails. Owing, however, to the fact that it is practically impossible at all times to insulate the rails adjacent to the ground, part of the current leaks into the earth and finds its way back to the station through the ground, and in doing so, if pipes, cable sheaths or steel work are under or adjacent and parallel to the tracks, some of it may return by these metallic structures. At some point or points this current must leave these metallic structures and usually does through the earth in the neighborhood of the power station or substation, causing electrolytic effects in the underground structure or conductor at the points in question, unless precautions have been taken, as later indicated.

There is less opportunity for current to escape from the tracks on electrified roads where the rails are above ground and rest on wooden ties in ballast and there is no opportunity for such escape where the return circuit does not enter the running rails, but is conducted back to the power station by independent and insulated contact rails or wires. Examples of this method of construction are found in slot conduit street railways and those having double overhead trolleys; also in those using a separate insulated return conductor rail.

It is common practice to connect the negative bus-bars in the power station or substations with the running rails by copper cables at the points nearest to the stations. Leakage of current from the rails to the adjacent water pipes along the line may thus occur, and the current flowing in these pipes leaves them and returns to the rails in the neighborhood of the power station, causing electrolysis at the points where it passes from the pipes through the earth.

Prevention.—It is possible to prevent electrolysis by precluding the escape of electric current from the return conductors, but frequently this is not practically possible, as in the case of buried rails carrying return current. Several methods of meeting this latter condition have been employed, briefly described as follows:

Drainage System.—In order to prevent this escape of current into the earth, negative cables are sometimes run from the power station or substation to adjacent pipes or metal work so that the current will leave these structures through metallic paths, thus preventing electrolysis at such points. This system is successfully used in connection with continuous cable sheaths or pipe lines having screw joints, although it results in inducing a larger volume of flow by these paths. joints, as frequently, however, in water pipe lines having lead joints, as frequently electrolysis is induced at the pipe joints.

Insulated Negative System.—Another system employed is to provide insulated cables which are connected to the rails at points remote from the station. It is largely employed in

Europe and is beginning to be specified in connection with the American systems. This has the effect of maintaining a more uniform and lower negative potential and largely prevents the current from leaving the bonded rails. The objection to this system is the high cost of the insulated copper cables, which must be relatively very large and which do not carry current to their full capacity.

Booster System.—A modification of the above system devised to compel the cables to carry current to their full capacity is known as the Booster system. In this system the cables carrying return current are connected to a low potential generator of large capacity which acts like a pump placed in a pipe line of low flow head to increase the volume of flow.

Other Systems.—There are sometimes peculiar local conditions of which advantage can be taken by an electrical engineer, but usually one or the other of the above systems, or combinations of them, are employed to safeguard metallic structures adjacent to the path of the return current.

The first heavy electric traction system in New York City was installed on the Brooklyn Bridge. The power was used principally to switch trains into position to grip a propelling cable. The current demand was usually small and no serious electrolytic problem arose. When, however, the trolley cars and electrified elevated trains crossed the bridge, the situation changed. The return current leaked to the bridge structure and streamed back to Brooklyn by all metallic paths, some even returning through the water of the East River. In 1900 sixty observation stations were established and as a result the bridge structure, particularly the cables, were heavily bonded to the traction tracks at the Brooklyn end and the voltage of the structure at the danger end was reduced.

Grand Central Terminal—New York City.

General.—In the Grand Central Terminal there are thousands of columns supporting terminal yards, streets and buildings and in the midst of them there is operated an electric railway with a grounded return. It is obvious that the means for adequately protecting this immensely valuable property must be most complete. This situation was early recognized and steps were taken as follows:

(1) A substation was located in the Terminal. This was done primarily to reduce the transmission losses, but it also made possible the maintenance of the structural steel at a low potential—a most important circumstances, as will appear later.

(2) This substation was connected to the return rails by seven 2,000,000 c.m. cables, which in consequence of their short length provided a return circuit of very low resistance.

(3) Independent negative cables were connected to the terminal steel and the Post Office Building, the first of the group of buildings which will cover the terminal.

(4) A system of inspection, in the nature of an electrolytic survey, was established with regular dates for inspections and a prescribed form of report.

Such precautions were adequate during the early stages of construction, but as additional steel was erected, the ratio of the resistance of the copper to the steel was steadily falling and the protection correspondingly became less effective.

Voltmeter Method.—The early electrolysis survey consisted of taking readings of the potential between the steel structure and the adjacent tracks, pipes, etc., and noting the direction of the flow. It was realized, however, that the difference of potential method was not satisfactory. For should a potential of four volts exist between a column and an adjacent pipe, it might be assumed that the situation required immediate attention, whereas if only one-tenth of a volt existed, the condition would be regarded as entirely satisfactory. As a matter of fact, if the four volts were due to there being good insulation between the columns and the pipe with no flow of current there would be no electrolytic action, while, on the other hand, if the one-tenth volt was due to a low resistance path over which a large volume of current was flowing, electrolysis would surely be taking place. In other words, the readings indicated only the potential difference between two points of a circuit and the important factor, the amount of current flow, was unknown. Appreciation of the incompleteness of this system of readings, which, however, is the one in common use, lead to the development of a new method, briefly described as follows:

Galvanometer Method.—The problem in the Grand Central Terminal is to protect the column bases. It is accepted that when current flows upwards from a column foundation that this column is free from any possible electrolytic damage. If, however, it flows downward to the foundation, then electrolysis is possible and it becomes important to know the volume of the current. There is one other condition, when the current reverses, sometimes flowing upward and sometimes downward. With equal reversals of current electrolysis is only one-thirtieth as destructive as when persisting in one direction. Because of the large sections of the Grand Central Terminal steel and the small current flowing, it was impossible with the instruments in common use to determine either the direction of flow or the volume of current. After investigation and experimental work a special portable galvanometer was constructed that would read to three-millionth (.000003) of a volt, per division. Reading points were established five ft. apart on the columns to be surveyed, the concrete protection being pierced and the steel columns drilled, a ¼-in. pipe inserted and the terminals of the instrument attached. By this method it has been possible to obtain readings on columns having a resistance as low as two hundred and thirty-five millionths (.00000235) of an ohm between terminals and current flows as low as one ampere in such a column can be read and its direction determined. The instrument has not proven too delicate for practical use.

A complete electrolytic survey of the terminal has been made and the current flow in each column measured, its direction ascertained and the data plotted. In general, the steel was found to be in a state of balance; current flowing up some columns, down others, and reversing in many of them. Such being the case, it appears that without much change the balance can be deflected to the safe side by making the current flow up all the columns, all the time, and that condition made permanent.

Upward Drainage System.—To effectually drain the steel structure and cause all current to flow up the columns, it is first necessary to directly connect the steel deck and the upper tracks with the substation negative bus by short cables of large cross-section, and second, to remove all metallic connections between the tracks and the steel structure. In view of the enormous section of this steel and the small current it carries, the steel work may be at a slightly higher potential than the substation negative bus and all escaping current will tend to flow towards it, which is in the harmless direction. However, to make sure and to accentuate this action, especially at the column bases, it is proposed by an arrangement of circuits to raise the potential of the lower level track rails so that at all times they and the surrounding earth will be strongly positive to the columns, thus preventing any flow of current from the columns into the earth without which there can be no electrolysis.

The above described plans of reducing the potential of the structure and draining it upward to the substation is now in course of execution. The water pipes and gas pipes crossing the Grand Central Terminal are carried on wooden supports and insulated from the steel structure, and when the work is completed all such pipes and their connections will be insulated from the steel structure and the negative conductors.

Recently the bases of some of the columns were exposed for examination and although some rusting was found, there was no distinct evidence of electrolysis. These columns have been in place carrying electrified track for six years.

An experimental electrolysis investigation has been started to determine the best means of protecting future structures by various compounds and processes and to determine the amount of electrolysis per square foot of steel per year under a given flow of current when the steel is painted and enclosed in concrete in accordance with standard practice.

Pennsylvania Terminal—New York City.

This system is operated with a grounded return and no attempt has been made to insulate the negative conductors from the ground. In the return circuits both track rails are used except at interlockings. All lead-covered cables in each manhole are covered with asbestos and steel tape and the lead sheaths bonded together. The sheaths of all cables are bonded to the negative wires at each substation, in order to take the current flowing in the sheaths back over a cable and thus prevent damage by electrolysis. The sheaths almost without exception are negative to tracks and tunnel linings. There are 25 cables, including high and low tension, control and telephone cables leaving the power house, and two 5,000,000 c.m. bare negative cables connecting the negative bus in the substation with the rails at the nearest point to the power house. The lead sheaths of the above cables are equivalent to about 2,400,000 c.m. of copper. There have been only two cases of trouble caused by electrolysis of lead sheaths and they have been remedied by locally bonding them at points of outflow of current.

A number of examinations of the rails, tie-plates and screw spikes have been made at various points on the system, but no serious trouble has been found. The rails and tie-plates are found to be in good condition at all points.

There has been no trouble with water pipes, which run parallel with the tracks. The signal air pipes are carrying considerable current at times, due to insufficient cross-bond-

ing between the tracks in one of the yards. This trouble is being remedied by bonding at local points and by installing additional cross-bonding between tracks. Regular investigations are made to determine the amount of current on the steel columns and girders in the station area and almost no current has been found. No trouble has developed and there are no indications to lead one to expect any trouble.

The track bonds are tested every year and the cross-bonding is frequently inspected. Very few bad bonds are found. Provision is made at each station to find the amount of current carried on the cable sheaths. Readings of these amounts are taken frequently and when any material increase or decrease in these amounts is found the matter is looked into. By keeping the cable sheaths bonded together and negative to tracks and iron, no trouble is anticipated from electrolysis.

Baltimore & Ohio Railroad—Baltimore, Md.

Electric propulsion is in use on the Baltimore & Ohio from the vicinity of its power house just west of Camden station, Baltimore to Waverly, 3.73 miles east; 1.11 miles of this line is four-tracked, the rest being double-tracked. Within the electric territory there is a total of 1.79 miles of tunnel, the longest of which is Howard Street Tunnel, 7,340 ft. in length. The grade varies from 1 per cent. to 1½ per cent. towards the east. Two motors drawing 5,000 amperes under maximum tonnage of 2,250 tons are used on the trains up the hill, eastbound. Westbound trains drift through the tunnel, the motors returning light. The track is well constructed of 100-lb. rail on good ties and clean stone ballast. The subsoil consists of heavy clay and is in places wet. Drainage conditions are good. The track is high and dry and conditions are such as to discourage the escaping of currents as much as are usual in track circuits. In Howard Street Tunnel drainage is effected by a conduit between the tracks, the track being carried on stone ballast; this in turn on one-man stone, the latter resting on the inverted arch of the tunnel. Conditions here are generally wet. There is a heavy seepage of water through the walls of the tunnel, which in places saturates the ballast and ties, the water escaping through the ballast to the conduits between tracks.

The electric system is direct current, 750 volts, third rail contact, and return through running rails. The power is supplied at two points; the Company's power house at Camden and the substation at Mt. Royal, at which purchased power is furnished. The positive conductor consists of 100-lb. R. B. section rail placed in 1912 in Howard Street Tunnel, and 80-lb. Mexican Central rail placed in 1901 over other parts of the line. Previous to the renewal of third rail in the tunnel in 1912, 1901 Mexican Central 80-lb. rail had been in use. The renewal was made necessary by the corroded and eaten condition of the rail, especially at wet points, where one-third of the rail section had disappeared. Previous to the renewal, the insulation and bonding had not been of the best, having greatly deteriorated since installation. The eastbound third rail is reinforced by two 1,000,000 c.m. copper cables from the power house to Huntington avenue, laying in close contact with its base. The westbound rail is not reinforced. The east and westbound third rail are cross-bound every 300 ft. in the tunnel and every 1,000 ft. over the rest of the territory. The third rail is bonded at the joints with the two 500,000 c.m. copper bonds. The negative conductor consists of the running rail, 100-lb. titanium in Howard Street tunnel and 100-lb. A. S. C. E. Bessemer on the other parts of the line. The rails are reinforced through the four-track territory and through Howard Street tunnel by a 1,000,000 c.m. copper cable. This cable is uninsulated and is covered with stone ballast laying between tracks throughout the four-track territory and on the footing course of the tunnel throughout Howard Street tunnel. It was installed in 1901, and has been much patched on account of deterioration. The running rails and negative cable are cross-bonded every 1,000 ft. The rail joints are bonded with one 500,000 c.m. copper bond. The negative bus bars at Camden power house and Mt. Royal substation are connected with the negative conductor and neither is grounded at the respective points in question.

The evidence of electrolysis observed has been the corroding and eating away of negative conductors. The running rail now in Howard Street tunnel, laid in 1910, already shows pitting at points where the ties are saturated and is eaten away slightly at the spikes. The rail removed from the tunnel in 1910 had been in the track for three years only and was so far corroded and eaten at the base that its removal was necessary. Just how much the gases of the tunnel assisted in the deterioration of the rail, we are unable to say. Outside the tunnel where the gas factor does not exist and where the drainage is good, there is still unmistakable evidence of electrolysis. The rail here was laid in 1906 and 1908. Its base is pitted and eaten away, especially in the vicinity of the spikes, where a semi-circle of metal has disappeared about each spike. The spikes themselves deteriorate rapidly, requiring renewal about once in two years, in some cases the head entirely disappearing in this time. The 1906 rail is intended for renewal next year. It appears that we are getting about twice the life out of the rail in the electric zone outside the tunnel that we are getting in the tunnel, and that the renewal in both cases is due to the action of electric currents rather than mechanical wear. Data on electrolytic action on neighboring water and gas pipes caused by escaping currents from the Baltimore & Ohio Railroad System are meager, no survey having been made. The city water works several years ago made connection between their pipes and the negative conductors at the power house in order to concentrate the discharge from their pipes, but how serious the difficulty was they were trying to remedy or the result of the connection is unknown. Two years ago, so much difficulty had been experienced in maintaining the Company's water pipes at Mt. Royal that these also were connected electrically to the negative conductor. Time enough has not yet elapsed to note the effect. A neighboring railroad has several times complained of injury to its water pipes at North avenue and various arrangements for improving the negative conductors have been resorted to, but the trouble has not yet been eliminated. A test shows Baltimore & Ohio rail four volts negative to pipes at this point, except when motors are passing, when Baltimore & Ohio rail is five volts positive to pipes. Connection will probably be made between the pipes and negative return of Baltimore & Ohio circuit. Nothing definite can be shown regarding stray currents from the Baltimore & Ohio rails until survey has been made.

RECOMMENDATIONS FOR NEXT YEAR'S WORK.

The Rules and Regulations of the National Fire Protection Association are frequently used by the National Board of Fire-Underwriters in formulating rules and instructions for the guidance of their inspectors, and since the wiring and other electrical work of the railroad companies must conform to the rules and requirements of the Underwriters' Association, it is the recommendation of this committee that a representative of the Association be delegated to serve with the National Fire Protection Association.

This committee respectfully recommends the continuation of work already outlined, particularly consideration of "Clearance for overhead third rail working conductors and automatic safety stops," "Electrolysis" and "Insulation" and the consideration of any new information that may develop in reference to "Maintenance Organization" and "Relation to track structures."

George W. Kittredge (N. Y. C. & H. R.), chairman; J. B. Austin, Jr. (L. I.), vice-chairman; D. J. Brumley (I. C.), R. D. Coombs (Cons. Engr.), A. O. Cunningham (Wabash), L. C. Fritch (C. G. W.), Geo. Gibbs (P. R. R.), G. A. Harwood (N. Y. C. & H. R.), E. B. Katte (N. Y. C. & H. R.), C. E. Lindsay (N. Y. C. & H. R.), W. S. Murray (N. Y., N. H. & H.), Frank Rhea (Cons. Engr.), J. W. Reid (C. & A.), A. F. Robinson (A. T. & S. F.), J. R. Savage (L. I.), Martin Schreiber (Public Service Rys.), W. I. Trench (B. & O.), H. U. Wallace (Cons. Engr.), committee.

Discussion on Electricity.

Mr. Kittredge: The report is one of progress and information. Under the heading "Transmission lines and crossings," we desire to have the last sentence of that section read: "Your committee, however, is not prepared at this time to make any further recommendations for the reason that more time is required to study the development of the art in respect to voltages over 70,000, and further, because of the fact that all of the various similar associations have not yet modified theirs or formally adopted ours so as to make a uniform specification. We know of no reason, however, why those that have not should not do so as opportunity for revision comes up. In other words, our specifications are not objectionable."

Under "Electrolysis," we want to substitute for the members of the joint committee appointed by the American Electric Railway Association Messrs. Townley, Richey and Palmer.

The President: If there is no objection the changes desired by the committee will be made and the report of the committee accepted. Are there any remarks? If not, the committee is relieved with the thanks of the association.

CONSERVATION OF NATURAL RESOURCES.

The Committee has under consideration the fostering of closer relations between it and the officers of the National Commission, as well as with the National Association of State Conservation Commissioners and the Western Forestry and Conservation Association, believing as it does that more officially recognized co-operation with these Asso-

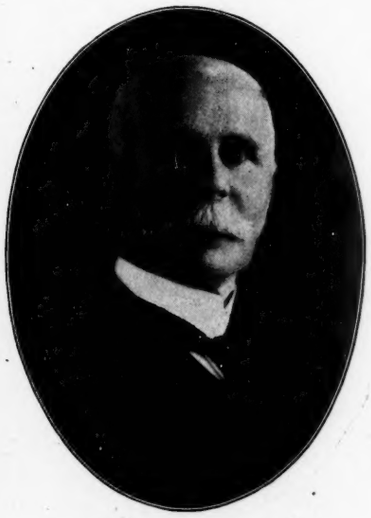
ciations would be conducive to the attaining of the general objects for which Conservation Commissions were established, and more particularly those features in which the railways are vitally interested.

DOMINION OF CANADA.

Tree Planting and Reforestation.

The Forestry Branch, Department of the Interior, has taken the lead in connection with forest planting in Canada. The forest nursery at Indian Head, Sask., has been furnishing a constantly increasing amount of plant material for free distribution among the farmers of the prairie provinces. The number of trees and cuttings sent out has increased steadily from 48,000 in 1901 to 2,729,135 in 1912, with a total all told, of approximately 23,000,000. These trees are scattered in small plantations throughout the settled portions of Alberta, Saskatchewan and Manitoba, so the actual showing is much greater than the number alone would indicate.

In addition to supplying trees for distribution to farmers, the Forestry Branch is inaugurating a policy of reforestation on the Dominion Forest Reserves in the prairie provinces. Some of these reserves, entirely surrounded by large farming sections, formerly supported a good forest growth, but are now largely denuded as a result of forest fires.



WILLIAM McNAB,
Chairman Committee on Conservation of Natural Resources.

The Department of Agriculture of the Province of Ontario has, since 1904, encouraged the development of farmers' woodlots, through the distribution of trees and cuttings. The principal tree-planting activity in the Province of Quebec has been in connection with the fixation of certain areas of shifting sands in the eastern portion of the Province. About 300 acres of shifting sands at Lachute have been purchased at $1 an acre from farmers who have the privilege of buying it back within the first 15 years at a price covering the original cost, the cost of reforestation and interest at 4 per cent. The Province, however, guarantees that the cost of such repurchased lands shall not exceed $10 an acre. On the area purchased, 40,000 white pine, white spruce, elm and green ash seedlings were planted in 1912. At Berthierville there is a government forest nursery where forestry students are trained each Spring in reforestation.

The Canadian Pacific has done considerable planting along its line in the prairie sections in places where there has been trouble with drifting snow. The intention is to secure a growth of trees which shall replace the numerous snow fences along portions of the line. This company is also encouraging the planting of trees and shrubs for shelter-belt purposes by farmers who have purchased land from the company in specified sections of Southern Alberta. One-half the trees required are furnished free, and prizes are offered for the best plantations.

Prevention of Fires from Railways.

On May 22, 1912, the Board of Railway Commissioners for Canada issued an order requiring railways subject to its jurisdiction to take certain measures for the prevention of forest and grass fires along their lines. This order included in a slightly modified form provisions contained in former orders for the use and inspection of fire-protective appliances on locomotives, the construction of fireguards in the prairie provinces and the non-use of lignite coal. In addition, provision was made for the appointment of a chief fire inspector, who is given authority to prescribe special patrols to be maintained by the railway companies where such action is considered necessary. The regulation of the burning of inflammable material along the rights-of-way during the fire season is also provided for. Railway employes are required to report and extinguish railway fires, and any fires starting or burning within 300 feet of the track are presumed to have started from the railway, unless proof to the contrary is furnished.

Regulations of a similar nature have been issued by the Public Utilities Commission of the Province of Quebec, applicable to provincially chartered railways. The prevention of railway fires along provincially chartered lines in British Columbia, through the adoption of similar measures, is provided for by the new Forest Act, which became law early in 1912.

Order of the Board of Railway Commissioners for Canada, Describing Regulations to be Adopted by Railway Companies for the Prevention of Fires.

2. Until further order, every railway subject to the legislative authority of the Parliament of Canada, under construction, or being operated by steam, shall, unless exempted by a special order of the board, cause every locomotive engine used on the said railway, or portion of railway, being constructed or operated by it, to be fitted and kept fitted with netting mesh as hereinafter set forth, namely:

(a) On every engine equipped with an extension smoke-box, the mesh shall be not larger than 2½x2½ per inch of No. 10 Birmingham wire gauge, and shall be placed in the smoke-box so as to extend completely over the aperture through which the smoke ascends, the openings of the said mesh not to exceed 17-64 inch to the square.

(b) On every engine equipped with a diamond stack, the mesh shall be not more than 3x3 per inch of No. 10 Birmingham wire gauge, and shall be placed at the flare of the diamond of the stack, so as to cover the same completely, the openings of the said mesh not to exceed 13-64 inch to the square.

3. Every such railway company shall cause—

(a) The openings of the ashpans on every locomotive engine used on the railway, or portion of railway, operated or being constructed by it, to be covered, when practicable, with heavy sheet-iron dampers; and, if not practicable, with screen netting dampers 2½x2½ per inch of No. 10 Birmingham wire gauge, such dampers to be fastened either by a heavy spring or by a split cotter and pins, or by such other method as may be approved by the board.

(b) Overflow pipes from lifting injectors, or from water pipes, from injector-delivery pipe, or from boiler, to be put into the front and back part of the ash pans and used from the first day of April to the first day of Nnvember, or during such portion of this period as the board may prescribe for wetting ashpans.

4. Every such railway company shall provide inspectors at terminal or division points where its locomotive engines are housed and repaired, and cause them, in addition to the duties to which they may be assigned by the officials of the railway companies in charge of such terminal or division points—

(a) To examine, at least once a week—
- (1) The nettings;
- (2) Dead plates;
- (3) Ash pans;
- (4) Dampers;
- (5) Slides; and
- (6) Any other fire-protective appliance or appliances used on any and all engines running into the said terminal or divisional points.

(b) To keep a record of every inspection in a book to be furnished by the railway company for the purpose, showing—
- (1) The numbers of the engines inspected;
- (2) The date and hour of day of such inspection;
- (3) The condition of the said fire-protective appliances and arrangements; and
- (4) A record of repairs made in any of the above-mentioned fire-protective appliances.

The said book to be open for inspection by the chief fire inspector or other authorized officer of the board.

(c) In case any of the said fire-protective appliances in any locomotive are found to be defective, said locomotive shall be removed from service and shall not (during said prescribed period) be returned to service, unless and until such defects are remedied.

(d) Every such railway company shall also appoint one or more special inspectors, as may be needed, whose duties shall be to make an independent examination of the fire-protective appliances on all the locomotives of such company, at least once each month, and report the condition of such fire-protective appliances direct to the chief mechanical officer of the railway company, or other chief officer held responsible for the condition of the motive power of said company.

5. Any authorized officer of the board shall have power to inspect at any time any and all locomotives, and may remove from service any locomotive which is found to be defective in the said fire-protective appliances; and any such locomotive so removed from service, shall not (during the said prescribed period) be returned to service unless and until such defects are remedied.

6. No employe of any railway company shall—

(a) Do, or in any way cause, damage to the netting on the engine smokestack or to the netting in the front end of such engine;

(b) Open the back dampers of such engine while running ahead, or the front dampers while running tender first;

(c) Or otherwise do or cause damage or injury to any of the fire-protective appliances on the said engine.

7. No such railway company shall permit fire, live coals, or ashes, to be deposited upon its tracks or right-of-way outside of the yard limits, unless they are extinguished immediately thereafter.

8. No such railway company shall burn lignite coal on its locomotive engines as fuel for transportation purposes, unless otherwise ordered by the board—lignite, coal consisting of and including all varieties of coal between peat and bituminous, with a carbon-hydrogen ratio of 11.2 or less, such ratio being based an analysis of air-dried coal.

9. Every such railway company shall establish and maintain fire-guards along the route of its railway as the chief fire inspector may prescribe. The nature, extent, establishment and maintenance of such fire-guards shall be determined as follows:

(a) The chief fire inspector shall each year prepare and submit to every such railway company a statement of the measures necessary for establishing and maintaining the routes of such railways in a condition safe from fire, so far as may be practicable.

(b) Said measures may provide for the cutting and disposal by fire, or otherwise, of all or any growth of an inflammable character, and the burning or other disposal of debris and litter on a strip of sufficient width on one or both sides of the track; the plowing or digging of land in strips of sufficient width on one or both sides of the track; and such other work as may, under the existing local conditions and at reasonable expense, tend to reduce to a minimum the occurrence and spread of fire.

(c) Said statements of the chief fire inspector shall be so arranged as to deal with and prescribe measures for each separate portion of such railway upon and adjacent to which the fire risk calls for specific treatment. The intention shall be to adjust the protective measures to the local conditions and to make the expense proportionate to the fire risk and the possible damage.

(d) Said statements of the chief fire inspector shall prescribe dates on or within which the foregoing protective measures shall be commenced and completed, and the fire-guards maintained in a clean and safe condition.

(e) No such railway company shall permit its employes, agents, or contractors to enter upon land under cultivation, to construct fire-guards, without the consent of the owner or occupant of such land.

(f) Wherever the owner or occupant of such land objects to the construction of fire-guards, on the ground that the said construction would involve unreasonable loss or damage to property, the company shall at once refer the matter to the board, giving full particulars thereof, and shall in the meantime refrain from proceeding with the work.

(g) No agent, employe, or contractor of any such railway company, shall permit gates to be left open or to cut or leave fences down whereby stock or crops may be injured, or do any other unnecessary damage to property, in the construction of fire-guards.

10. In carrying out the provisions of Section 297 of the Railway Act, which enacts that "the company shall at all times maintain and keep its right-of-way free from dead or dry grass, weeds, and other unnecessary combustible matter," no such railway company or its agents, employes, or contractors, shall, between the first day of April and the first day of November, burn or cause to be burned any ties, cuttings, debris or litter upon or near its right-of-way, except under such supervision as will prevent such fires from spreading beyond the strip being cleared. The chief fire inspector or other authorized officer of the board may require that no such burning be done along specified portions of the line of any such railway, except with the written permission or under the direction of the chief fire inspector or other authorized officer of the board.

11. The railway company shall provide and maintain a force of fire-rangers fit and sufficient for efficient patrol and fire-fighting duty during the period from the first day of April to the first day of November of each year; and the methods of such force shall be subject to the supervision and direction of the chief fire inspector or other authorized officer of the board.

12. The chief fire inspector shall, each year, prepare and submit to each and every railway company a statement of the measures such railway companies shall take for the establishment and maintenance of said specially organized force. Said statements, among other matters, may provide for—

(a) The number of men to be employed and the said force, their location and general duties, and the methods and frequency of the patrol;

(b) The acquisition and location of necessary equipment for transporting the said force from place to place and the acquisition and distribution of suitable fire-fighting tools; and

(c) Any other measures which are considered by him to be essential for the immediate control of fire and may be adopted at reasonable expense.

13. Whenever and while all the locomotive engines used upon any such railway, or any portion of it, burn nothing but oil as fuel, during the aforesaid prescribed period, under said conditions as the board may approve, the board will relieve the said railway of such portions of these regulations as may seem to it safe and expedient.

14. The sectionmen and other employes, agents, and contractors of every such railway company shall take measures to report and extinguish fires on or near the right-of-way, as follows:

(a) Conductors, engineers, or trainmen who discover or receive notice of the existence and location of a fire burning upon or near the right-of-way, or of a fire which threatens land adjacent to the right-of-way, shall report the same to the agent or persons in charge at the next point at which there shall be communication by telegraph or telephone, and to the first section employes passed. Notice of such fire shall also be given immediately by a system of warning whistles.

(b) It shall be the duty of the agent or person so informed to notify immediately the nearest forest officer and the nearest section employes of the railway, of the existence and location of such fire.

(c) When fire is discovered, presumably started by the railway, such sectionmen or other employes of the railway as are available shall, either independent or at the request of any authorized forest officer, proceed to the fire immediately and take action to extinguish it; provided such sectionmen or other employes are not at the time engaged in labors immediately necessary to the safety of trains.

(d) In case the sectionmen or other employes available are not a sufficient force to extinguish the fire promptly, the railway company, shall, either independently or at the request of any authorized forest officer, employ such other laborers as may be necessary to extinguish the fire; and as soon as a sufficient number of men, other than the sectionmen and regular employes are obtained. the sectionmen and other regular employes shall be allowed to resume their regular duties.

Note.—Any fire starting or burning within 300 feet of the railway track, shall be presumed to have started from the railway, unless proof to the contrary is furnished.

15. Every such railway company shall give particular instructions to its employes in relation to the foregoing regulations, and shall cause appropriate notices to be posted at all stations along its lines of railway.

16. Every such railway company allowing or permitting the violation of, or in any respect, contravening or failing to obey any of the foregoing regulations, shall, in addi-

tion to any other liability which the said company may have incurred, be subject to a penalty of one hundred dollars for every such offense.

17. If any employe or other person included in the said regulations, fails or neglects to obey the same, or any of them, he shall, in addition to any other liability which he may have incurred, be subject to a penalty of twenty-five dollars for every such offense.

Coal Resources.

As a result of an investigation by the Commission of Conservation it was found that there was in Saskatchewan, Alberta and British Columbia, a considerable waste of slack coal which had been mined and brought to the surface. This waste of unmarketable slack coal varies from 10 to 35 per cent of the output. In Saskatchewan, 10 to 25 per cent of the output from the mines is slack coal, which is dumped on the ground and wasted. In the vicinity of Estevan, 10 to 12 per cent of the output from some of the larger mines is dumped on the prairie and burned. It is necessary to remove this coal (lignite) from the mine plant, as it readily ignites by spontaneous combustion.

The waste of slack coal varies from 10 to 12 per cent in the Lethbridge district, and from 20 to 35 per cent in the Edmonton district. In the Crowsnest Pass district, in Alberta and British Columbia, the coal is of better grade and some of the slack is marketable; the remainder is made into coke in beehive coke ovens. At Bankhead, briquettes are made from the slack coal. On Vancouver Island, some of the large producing mines waste from 10 to 15 per cent of their output as slack coal, and, unfortunately, it is generally dumped into the sea. The high freight rates make it impossible to market this slack at a profit.

In order to save the community what amounts to more than 15 per cent of the total output of coal, besides the low-grade coal which is often left in the mine, it was suggested that the following studies be made:

(1) To ascertain the price of coal in different parts of the West, and which portions of the country are supplied with coal from the different mining centers, also the prices of coal in Canada and the freight rates on the same from the mines to the market.

(2) Owing to the necessity of obtaining a suitable domestic fuel and cheap power for the prairie provinces, it is desirable that investigations be carried on with a view to utilizing the lignites which underlie the greater portion of these provinces. In this connection, it is of interest to know that the United States Bureau of Mines has demonstrated that suitable briquettes can be made from low-grade lignites. The bureau has also shown that many fuels of such low-grade as to be practically valueless for steaming purposes, including slack coal, bone coal, and lignite, may be economically converted into producer gas and may thus generate sufficient power to render them of high commercial value.

Petroleum Resources.

While the actual petroleum resources of Canada are comparatively small, nevertheless, the potential resources are considerable. In New Brunswick and Nova Scotia there are enormous deposits of oil shales which are valuable as a source of oil. On an average these shales will give a higher yield of crude oil per ton than the oil shales worked so extensively in Scotland. In the vicinity of Fort McMurray and Fort McKay, on the Athabaska River, Alberta, there are enormous deposits of tar sands. The bitumen in the tar sands is the residue from evaporated petroleum. It has been estimated that there is 6½ cubic miles of solid bitumen in the tar sands exposed on this river. Although enormous quantities of oil have evaporated from this district, nevertheless it seems probable that accumulations of petroleum may exist in places where the geological structure was such as to prevent its escape. This is also exemplified by the fact that natural gas occurs in quantity in districts where the tar sands are capped by overlying measures. If large quantities of petroleum were discovered in Alberta it would be a factor of great importance to the railway interests which operate in the Rocky Mountains and Jasper Parks and the forest areas in British Columbia and Alberta.

The Canadian Pacific is now using oil-burning engines on its main line between Kamloops and Field, in British Columbia. The Grand Trunk Pacific and some of the Canadian Pacific coast steamships also burn oil, and other boats are being changed from coal-burners to oil-burners. The oil is at present obtained from the California oil fields. If supplies can be obtained at the prices now prevailing, its use will be very largely extended. Its cleanliness, the greatly decreased smoke, the decrease in the number of firemen required, the economy, particularly in intermittent service, the increased efficiency—two boilers with oil, in steamship service, giving the same steam as three with coal—and other considerations, make it an almost ideal fuel.

William McNab (G. T.), Chairman; R. H. Aishton (C. & N. W.), Moses Burpee (B. & A.), F. F. Busteed (C. P. R.), A. W. Carpenter (N. Y. C. & H. R.), C. H. Fisk (Chat. Sou.), W. A. McGonagle (D. M. & N.), G. A. Mountain (Can. Ry. Com.), W. L. Park (I. C.), G. H. Webb (M. C.), R. C. Young (L. S. & I.), committee.

Discussion on Conservation of Natural Resources.

Mr. McNab: This report on conservation may be accepted as one of progress.

L. A. Downs (I. C.): I have not been clear in my mind as to why this association fosters this committee on conservation of natural resources. We are an association of builders. Unfortunately, in this country, at the present time, conservation is getting mixed up with the differences between the "interests" and the common people. I was in Alaska this past summer, and Alaska is dead. It is dead because of the conservation policy in this country.

The Copper River and Northwestern Railroad operates 194 miles of road in Alaska. They had been burning coal in their locomotives until about a year ago, importing the coal from Canada and paying a duty on it, while the hills of Alaska are full of coal, but the laws of the United States preventing them from getting the coal out of the hills. This road is now burning oil in its locomotives because oil is cheaper than coal which they buy in Canada and pay a duty on it.

I think that God, in His Almighty wisdom, never intended, when he placed us on this continent, that we would run out of anything. While some things have become somewhat scarcer, I question whether you can recall anything which we have run out of entirely.

It seems to me if we could have a committee to prevent waste, a committee to prevent forest fires and other things, rather than a committee of conservation as holding the opinions of those great conservators in this country who seem to array the "interests" against the common people, then it would be all right.

Prof. S. N. Williams (Cornell College): Unfortunately in this country we have suffered during the past four or five years to the extent of millions of dollars by forest fires which have been caused by the railways. I know that in some cases the railways have not taken the precautions to prevent forest fires, and have not provided the means for the extinguishment of forest fires, after they have started along the lines of the railways, which they should have done. I think if you have paid any attention to the situation in this country for the last five years you will be convinced that this is one of the most important subjects which can be presented to us in the association, and still further that the matter of reforestation, which has been considered to be so important in Europe and which has been developed to a limited extent in our own country, is one of the most practical matters which can be considered.

George W. Andrews (B. & O.): The gross waste of timber in this country has been outrageous. There are probably no corporations in the world to-day that are suffering more on account of the gross waste of timber than the railroads, and many important railroad systems in this country have realized that fact, and they have gone into the planting of trees on an extensive scale, and many others are contemplating doing it.

Mr. McNab: Now, gentlemen, this question of conservation is one concerning which we must divorce from our minds the idea that it has anything to do with any one country. Whatever interests Canada in the way of conservation interests the United States. We are all really working for the conservation of the resources of the one continent.

J. L. Campbell (E. P. S. W.): I understand that primarily conservation is intended to provide for the efficient and economical use of our resources, saving those parts of our resources which we do not need for the present for future generations, and I believe we can all agree on that feature of conservation. As engineers, I believe it is our special duty to see that the resources of the country which we handle are efficiently and economically used.

R. C. Young (L. S. & I.): The railroads are interested in conservation in many ways. In the first place, a great many of our railroads are dependent more or less for their business on the products of the forest and the products of

the mines. I do not think it is our province to conserve these products to such an extent that they cannot be used, but to see to it that they are conserved to such an extent that they can be used at the right time, and the portions not used now will be conserved for use by future generations.

Prof. Williams: One of our governmental departments has recently made the statement that the annual waste of resinous products in the United States is estimated at 15,000,000 cords, and if made up into paper-making products in the shape of wood pulp would be worth $300,000,000. I think that is a sufficient commentary on the waste which is being practiced at the present time. The Chicago & North-Western, and I believe also the Pere Marquette, some time since issued a circular letter to all the agents of these railways advising them that they must be careful in the use of the stub ends of pencils, and also in the use of pens, and all the other office stationery, and giving an estimate as to the waste which was being incurred in the use of these articles.

(The report was received and the committee relieved.)

BALLAST.

The work assigned to the Ballast committee was divided between three sub-committees, as follows:

PROPER DEPTH OF BALLAST OF VARIOUS KINDS TO INSURE UNIFORM DISTRIBUTION OF LOADS ON ROADWAY.

In last year's report on this subject the committee had as a basis for its report several reliable and thorough tests,

H. E. HALE,
Chairman Committee on Ballast.

such as the tests made by the Pennsylvania railroad at Altoona and by Director Schubert, of the German Railways, and on the information obtained for these tests the committee drew its conclusions and made its recommendations to the association, which recommendations covered the subject as far as the information permitted. These recommendations were printed in the report of 1912, and adopted by the association, but the subject in a modified form was again referred to the committee.

The tests on which the committee based its conclusions have been conducted largely under artificial conditions, which were designed to be, as nearly as possible, those which actually existed in the track under regular traffic, but under the circumstances it was impossible to absolutely reproduce conditions existing in track under regular traffic.

Careful search has been made to obtain reports or results of tests on this subject, both in foreign and American engineering papers, and this search has been practically without result. It therefore appears that if further investigation or report is to be made by the committee, it must be based upon new tests, which should be made in track under regular traffic—preferably heavy traffic.

Discussion of this subject by the committee with other members of the association has led the committee to believe that many members of the association feel that a further test in track under regular traffic is desirable, and to place this before the association in tangible form, the committee has worked out the following proposed test:

Proposed Test to Determine Proper Depth of Ballast of Various Kinds to Insure Uniform Distribution of Loads.

(1) Select a stretch of track on clay roadbed, under heavy traffic, where trouble has been experienced with clay working up between the ties.

(2) Excavate the roadbed to a uniform depth of 30 in. below the bottom of the ties, for a space of two rail lengths; prepare the adjacent rail lengths in the same manner, decreasing the depth 3 in. under each successive two rails, until the bed is 12 in. below the bottom of the tie (14 rail lengths).

(3) Place on this bed a thin layer of fibrous material, such as hay, to make a well-defined separation between the roadbed and the ballast.

(4) Place stone ballast on the bed to the above-mentioned depths, tamp well, and put the track in good line and surface.

(5) Make note of tie spacing and width of ties, keep accurate levels and record of amount of time spent on surfacing various parts o. track, also keep record of axle loads and amount of traffic. Take photographs at regular intervals to show deformation of roadbed.

(6) Make similar test for gravel and similar for ballast section, having a sub-ballast of gravel equal to one-half the total depth and a top ballast of stone equal to one-half the total depth of ballast.

(7) The estimated cost of this test is as follows:

(a)	Cost of material (stone), 500 yds. at 80 cents...	$ 400
(b)	Labor, preparing track and widening bank, where necessary, at $30 per rail (14 rails per test)..	420
(c)	Labor, inspecting, six inspections at $2 per rail.	170
(d)	Line and surface to be paid for by railway owning track, at regular maintenance charge.....	
	Total for one test.....	$ 990
	Three tests	$3,000

Conclusion.

The committee recommends that the above test be made under the direction and supervision of the Ballast committee, and that it be financed by the association or some railroad or railroads. The location for the test to be arranged for by the committee with a railroad that would be willing to have this test made in their main tracks under heavy, regular traffic.

CONTINUE STUDY OF PHYSICAL TESTS OF STONE FOR BALLAST.

The committee has previously recommended certain physical tests of stone for ballast, with full description of the tests and how to have same made by the United States Government at Washington. Further investigations by the committee this year have resulted in practically no additional information except a paper read at the Sixth Congress in New York of the International Society for Testing Materials by A. T. Goldbeck and F. M. Jackson, which quoted, in part, the table and data given in the American Railway Engineering Association report of 1912 and practically give the same information as given in our reports. The table showing results of physical test of stone for ballast, as presented to the association last year, has been checked, and the various railroads represented have advised that they had nothing further to add to the table. This table is considered by the committee to be a very good guide for comparing stone from various quarries when selecting it for ballast.

The further consideration of the physical tests of stone for ballast by the committee resulted in their recommending the physical tests as a guide only in the specifications for stone ballast, and it is recommended that the following note be added in the manual to the specifications for stone ballast.

Conclusion.

NOTE—"*Attention is called to the physical tests of stone for ballast printed in the manual, page 47, which are recommended as a guide, in connection with the specifications.*"

After further consideration of this subject, the committee feels that the information, as at present printed in the manual in regard to the physical tests of stone for ballast, was not clear to some of those who were not familiar with the subject, and it is recommended that the information given in the manual on this subject on page 47, under the heading of "Physical Tests of Stone for Ballast," be changed to read as follows (portion in italics is additional):

"It is recommended that the following be used for physical

tests of stone ballast. *Other things being equal, the maximum or minimum results as indicated will govern in selecting stone for ballast:*

(a) Weight per cubic foot—*Maximum.*
(b) Water absorption in pounds per cubic foot—*Minimum.*
(c) Per cent. of wear—*Minimum.*
(d) Hardness—*Maximum.*
(e) Toughness—*Maximum.*
(f) Cementing value—*Minimum.*
(g) Compression test—*Maximum.*"

SIZE OF STONE BALLAST.

The committee wishes to present to the association a copy of a report of a test made by the Pennsylvania railroad in regard to the first cost of putting in ballast and maintaining same for various sizes of stone ballast; the report is given below.

Sizes of Ballast.

Investigation conducted by the Pennsylvania company between August, 1899, and October, 1903, inclusive, record of experimental tests of three different sizes of broken stone ballast:

	Size of Stone Ballast.		
	¾ in	1½ in.	2½ in.
Double track ballast, feet.....	5,280	5,211	5,280
Double track ballast, miles.....	1.0	0.987	1.0
Stone ballast used, cars.....	228	171	198
Stone ballast used, tons.....	6,200.5	4,651.8	4,947.9
Cars stone per mile double track.	228	173	198
Tons stone per mile double track.	6,200	4,713	4,948
Linear ft. double track to 1 car..	23.1	30.5	26.7
Linear ft. double track to 1 ton..	.85	1.12	1.07
Average depth ballast under ties.	7.25 in.	6.5 in.	6.75 in.
Total first cost of ballast, freight, unloading, putting in tracks, lining and surfacing, etc.	$7,911.60	$5,633.51	$5,263.92
Average cost per ft. double track.	1.50	1.08	.997
Average cost per mile d'ble track	7,911.60	5,708.10	5,263.92
Cost ballast per ton at quarry...	60-70c	60-68c	58-69c
Average cost of maintenance for period of 51 months, per mile.	94.66	84.94	82.13

Conclusion.

After considering this information, the committee does not wish to make any change in the size of stone for ballast, as now recommended in the manual.

CONTINUE INVESTIGATION ON GRAVEL BALLAST AND RECOMMENDED METHODS OF GRADING DIFFERENT QUALITIES.

The committee has made extensive tests in regard to classification of gravel for ballast in past years. During this year Mr. Meade, chairman of the sub-committee on this subject, had a very thorough test made, which is presented herewith.

Tests made last year of river gravel gave results that indicated that gravel which was much higher in sand than called for in the manual for first-class roadbed gave first-class results, and, therefore, the committee was unwilling to approve the former recommendations, but further investigations this year show that the reason for this discrepancy was largely due to the use of improper screens and different methods of selecting the sample. The committee, therefore, wishes to incorporate in the manual a brief but complete description of the method of making the test of grading gravel for ballast, as follows:

Method of Testing Quality of Gravel for Ballast.

(1) The size of the sample to be tested should be approximately one cubic foot.

(2) Five average samples of about one cubic foot each should be selected from various parts of the pit, which is to be tested. The five samples should then be thoroughly mixed and about one cubic foot of the mixture selected for testing.

(3) To separate the gravel from the sand and dust use a No. ten (10) screen (ten meshes to the inch), made of No. 24 wire (B. & S. gage); to separate the sand from the dust use a No. fifty (50) screen (fifty meshes to the inch), made of No. 31 wire (B. & S. gage).

(4) Measure the percentage of gravel, sand and dust taken from the sample by volume, giving the percentage of each ingredient, compared to the volume of the sum of the ingredient, as follows:

$$\text{Per cent of sand} = \frac{S}{G + S + D}$$

Where S = Volume of sand.
G = Volume of gravel.
D = Volume of dust.

(5) When sample is shipped for test it should be carefully and securely marked with name and location of the pit from which it was taken.

The above will necessitate canceling the following paragraph on page 47 in the manual: "The term percentage above is used to indicate the proportion of the original bulk."

CLEANING STONE BALLAST.

Appendix B is a copy of report on cleaning stone ballast made by W. I. Trench, division engineer, to S. A. Jordan, engineer maintenance of way of the Baltimore & Ohio, which report was forwarded to the chairman after the last ballast committee meeting and is included as information. The investigation by Division Engineer Trench and Supervisor Zepp has resulted in a very material saving in this class of work.

RECOMMENDATIONS FOR NEXT YEAR'S WORK.

The committee recommends the following subjects for investigation for the year 1913:

(1) Further investigation of the proper depth of ballast of various kinds to insure uniform distribution of loads on roadway.

(2) Revise the ballast sections, with particular reference to the use of a sub and top ballast.

(3) Investigate methods of cleaning stone ballast and obtain cost of same by various methods.

H. E. Hale (M. P.), Chairman; J. M. Meade (A. T. & S. F.), Vice-Chairman; W. J. Bergen (N. Y. C. & St. L.), C. C. Hill (M. C.), A. F. Blaess (I. C.), S. A. Jordan (B. & O.), L. W. Baldwin (I. C.), William McNab (G. T.), T. C. Burpe (Inter-Colonial), A. S. Moore (C. C. C. & St. L.), O. H. Crittenden (I. & G. N.), J. V. Neubert (N. Y. C. & H. R.), F. T. Darrow (C. B. & Q.), S. B. Rice (R. F. & P.), J. M. Egan (I. C.), E. V. Smith (B. & O.), T. W. Fatherson (C. R. I. & P.), F. J. Stimson (G. R. & I.), H. L. Gordon (B. & O.), S. N. Williams, Cornell Colby, G. H. Harris (M. C.), Committee.

APPENDIX B.

CLEANING STONE BALLAST BY USE OF SCREENS.

By W. I. Trench,
Division Engineer, Baltimore & Ohio.

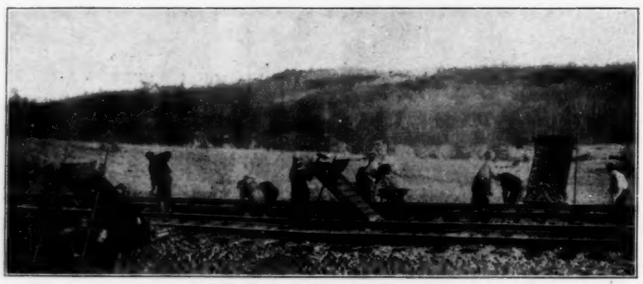
During the summer of 1912 experiments were made on the Baltimore & Ohio with screens in cleaning stone ballast, as opposed to the method of shaking out with ballast forks now generally in vogue on the railroads of this country. A screen developed by the writer and Supervisor A. G. Zepp of Baltimore is the subject of this discussion. In approaching the problem of cleaning ballast by means of screens it was recognized that the present methods involved one of the most expensive and tedious operations in railway maintenance and that for this reason the periodical cleanings are often deferred much longer than good practice would seem to demand. It was felt that if a screen could be designed which would make a proper separation of stone and dirt and at the same time dispose of these two materials in a way to avoid further handling, with a single cast of the shovel instead of the repeated sifting motion and the further shoveling of the dirt in its disposal as required by the fork, an enormous saving could be made.

It was believed that to be practicable this screen must be as cheap as was commensurate with durability, easily portable, and so related in position to the track when in use as to make its removal unnecessary on the passage of trains. Its operation must be progressive along the track and complete, working toward the dirty ballast and leaving the clean ballast behind it in such shape as to require no further handling. Its capacity must be limited only by the speed with which the laborers can handle the shovel, and it must be susceptible to use by a gang, so arranged that the work of every man is continuous and unchanging and so proportioned that no man's work is dependent on the progress made by another; that is, there should be no halts. It is believed that these results have been secured in the screen to be described and that its use, by a properly organized gang, will result in such a saving as to make the further general use of the fork method improbable.

Experiments on the Baltimore & Ohio were made on a portion of its double track line, and it was found that the most efficient gang for this condition was one of 12 men equipped with three screens. The photograph shows such a gang at work. It will be seen from this photograph that there is a screen for each berm and one for the center ditch. The construction of all three is identical, there being interchangeable legs for use on the berm and in the center ditch. The legs for use on the berm are so designed that the screen rides on the ends of the ties outside the rail at such a distance from the

track as not to interfere with traffic, and at the same time deposits the cleaned stone on the berm in final position. It stands at such an elevation that the dirt is deposited directly into a wheelbarrow standing on subgrade. The legs for use in the center ditch are designed to ride on the cleaned subgrade as the screen is slid along and are of such a height that the dirt is deposited in a handbarrow, which is placed beneath the screen, and the clean stone is left in the center ditch in final position. The upper end of the screen is carried on supports, which are readily adjustable in height to accommodate it for use in the center ditch or on the berm in either cut or fill. When in use in the center ditch the screen is laid flat upon the ground on the passage of trains and lies wholly below the top of rail.

A short description of the structural details will be made so that a better understanding will be had of the method of operation to follow. The screen frame is constructed of standard 2-in. x 3-in. x 1¼-in. angle iron set up so that the short leg turns out, the long leg forming the vertical sides of the screen. The screen proper is formed of ¼-in. rods, crimped together, giving a mesh ¾ in. x 8 in. It was found with this mesh and with the screen inclined at 45 deg. that the separation of stone and dirt was perfect even in damp weather, and this cannot always be said of the results secured from forks. These crimped rods are set in a rectangular steel frame made of 1-in. x ½-in. x ⅛-in. channel iron, and this frame is bolted inside the main frame so that the screen proper can be readily detached, as a whole, and sent to the shop for repairs. The entire screen is backed with a galvanized iron slide, which is so formed that it gathers the dirt which has come through any part of the screen and deposits it in a receptacle set beneath by means of a spout. The spout is really a hinged door suspended at its outer end by a chain and convenient fastening so that its height can be regulated, and when the receptacle is removed for emptying, can be



Ballast Screens on Double Track.

closed. With this door closed the screen will hold about one wheelbarrow load of dirt, so that the operation of the screen is not stopped while dirt is being dumped. At the top of the screen is a hood which is used in the position shown when in the center ditch, forming a deflector for the ballast thrown over the top, the method of operation in this case being to slide the screen backwards from the cleaned ballast towards the uncleaned ballast, the latter being thrown over the top and being left in clean condition at the bottom. When the screen is in use on the berm this hood is thrown back and forms the top against which the ballast is thrown when in this position. The screen constructed as indicated is practically indestructible and will support the weight of a man without impression.

A galvanized iron handbarrow for use with each screen is provided, which is so formed that it fits exactly upon the horizontal legs when in use on the berm, being so placed after a sufficient quantity of cleaned ballast has been allowed to fall outside the rail, the remainder being caught in the handbarrows and drawn across the rail to be deposited in the cribs. When in use in the center ditch the handbarrow is placed beneath to catch the dirt.

The cribs are cleaned to the bottom of the ties, the center ditch 18 in. below the top of rail and the berm 24 in. below top of rail at the end of tie and sloping to 3 ft. below top of rail at back of side ditch. Every 50 ft. one crib is cleaned to the bottom of the center ditch on one end and to the top of subgrade on the other, forming an outlet for water collected in the center ditch. This arrangement gives an absolutely dry and stable roadbed. The dirt from the ballast, or so much of it as is required, is dressed upon the subgrade outside the ballast line, and in addition to giving a neat black appearance and a pleasing contrast to the white stone ballast, serves to keep down weeds very effectually. What is not required for this purpose is used to widen the embankment along the line.

As stated above, for double track work, three screens are used. When tracks are on fills on both sides the dirt from each side screen is disposed of on its own side of the embankment, and the dirt from the center ditch is dumped directly from the handbarrow over the bank on the side most desirable. When one side is on a fill and the other side in a cut wheelbarrow loads of dirt are wheeled or carried bodily from the cut side to the fill side. When it is necessary to carry dirt across tracks care is used to keep the screen on the side from which it is carried in an advanced position, with reference to the other screens, so that the dirt will be carried over the uncleaned roadbed and not over that which has been cleaned. This is clearly illustrated in the photograph, where the side of the track towards the observer is in a cut and the other side on a fill. It will be seen that dirt carried to the fill on the other side of the tracks from the center screen passes over dirty ballast before the arrival of the screen to the right, and likewise, dirt from the screen to the left passes over the tracks before the arrival of either of the other two screens, the screens in this case traveling from right to left. When the tracks are in a cut, on both sides, wheelbarrow loads are wheeled out to the end of the cut at the nearest end, the handbarrow from the screen in the center ditch being dumped into a wheelbarrow or shoveled directly from the pan to the barrow standing across one rail. It is found that dirt can be wheeled out of a cut for a distance of 800 ft. to 1,000 ft. at less expense than would be the case if thrown upon the ground and loaded again upon a work train on a busy railroad.

The following gang organization is adhered to: For the operation of three screens, as indicated under ordinary circumstances, 12 men are sufficient; with long hauls of dirt, more men to be added for wheelbarrow work, so screen gang will be kept going. Of the 12 men two shovel from each side of berm onto their respective screens, two from the center ditch onto the center screen, and one man in the center of each track shoveling from the cribs onto the screen most available. One man with a pick advances ahead of the shovelers to loosen the hardened ballast before their arrival. These are dispensed with if ballast is loosened by means of a plow attached to the work engine. Long stretches of ballast can be loosened in this way in a short time by the work engine sufficient to keep a gang going for several days. The remaining three men are sufficient usually to handle wheelbarrows in disposal of dirt, dress dirt down on berm and fork a uniform ballast line, although if a hand laid ballast line is required, more men would be necessary. By careful handling of this gang ballast and dirt are disposed of at one operation in their final position and no further attention is necessary. In most cases it is found that the cleaning of ballast so reduces its volume that additional stone is necessary. In this case the disposition of the stone from the screens is so handled that the berms and center ditch are filled out completely, and any deficiency occurs between the rails where additional stone can be most conveniently distributed from Rodger ballast cars without further handling. The gang of 12 men cost per day: Foreman, $2.40; 11 laborers at $1.60, $19.60; total, $20.

We find that a gang equipped and organized as above will cover 165 ft. of double track per day of 10 hours, making the cost per mile of double track $640. This, of course, includes cleaning ballast, dressing ballast and disposal of dirt. Single track work would cost considerably less than half this amount, as there would be no center ditch to contend with. The ballast really handled in this test was considerably more than the cross-section would indicate, as before cleaning the ballast was piled above the rail in the center ditch and rounded high on the berm. An average of 227 wheelbarrow loads of dirt were removed per 100 ft. of double track cleaned.

For comparison with the fork method, the identical gang used above was tried with forks and advanced but 72 ft. per day. This also included the dressing complete and disposal of dirt, it being necessary to shovel the latter in wheel and handbarrows. This shows a cost per mile of double track, $1,466.

We see various figures given from time to time on the cost of cleaning ballast per mile. Some of them are very much less than the above, and we can only believe that this is occasioned by omitting to include the disposal of dirt and dressing the road complete, or on account of cleaning to a less depth in track than indicated above, or perhaps a less thorough separation of stone and dirt. In many cases a raise is given the track and the ballast is put under without cleaning. In the above test no raise was made. For the quality of work done we do not believe the figures can be much lessened. This shows a saving of 56 per cent by use of screens over forks.

This screen weighs about 325 lbs., and can be easily propelled along track by the two shovelers at work at the re-

spective screens, and with the material used in them with careful handling and pointing, they should last for years. The trial lot of three made for us with handbarrows complete by a Baltimore firm cost $45 each. We believe, if made in quantity and bid on by competitive firms, the cost would be greatly reauced.

Discussion on Ballast.

The President: This is a progress report, and is offered for information. The recommendation that funds be appropriated is a matter that will be handled by the directors, and we have reason to believe that it can be handled in some way. This report is submitted as a matter of information as to the methods of procedure that this committee proposes to follow.

John R. Leighty (M. P.): I would call attention to the very short distances over which the various depths of ballast proposed is to extend, under the heading of "Proposed Test." We all know that a bad spot in a track will grow like a bad spot anywhere else. It seems to me if you take 2 rail lengths of track under one condition and compare those 2 rail lengths with the adjacent 2 rail lengths, such a comparison will not lead to any definite information. The result of the test you get on one section of 2 rail lengths long will very materially influence the conditions that will be found on the adjacent 2 rail lengths, and it would be my suggestion in carrying out this experiment that the sections of track be made sufficiently long so as to make sure that the conditions existing on one section of track will not influence the conditions existing on an adjacent section of track, so that you will get a comparison which will really amount to something.

Mr. Hale: Concerning the investigation on gravel ballast and recommended methods of grading different qualities. Last year your committee obtained from various railroads report of the percentage of sand and dust in their ballast, and they tabulated this information and presented it to the association, but the results were so erratic that little conclusion could be drawn from it. One of the reasons for this, your committee found, was that the method of testing was not uniform; far from it. Some of the railroads weighed the ballast to determine the percentage of sand and dust, others measured it by volume and others had different methods of calculating the percentage. The committee felt it was of the first importance to have a uniform method of measuring or testing the sand in ballast, and, with that end in view, we have recommended the accompanying method, to be printed in the Manual.

C. C. Cook (B. & O.): That first "S" is confusing.

Mr. Hale: S means volume of sand.

Mr. Cook: In both cases?

Mr. Hale: In both cases.

E. A. Hadley (M. P.): I note that if this formula is adopted, it will change the wording in the Manual. Ballast is generally purchased by the cubic yard and generally the per cent. of sand in the ballast is specified; for instance, 35 per cent., which I understand to mean 35 per cent. of the original volume. It seems that in making the other formula the committee have omitted one of the component parts of the ballast, which is the voids, as without the voids the ballast will not properly serve its purpose, and should they add the voids in their formula they would still come out with 100 per cent. at the end. If the committee's suggestion is adopted it would add to the percentage of sand in the ballast, and as ordinarily accepted, it would amount to from 5 to 8 per cent., depending on the quality of the material. It seems to me in leaving out all consideration of the voids an omission has been made which should be corrected.

Mr. Hale: The committee considered that, but instead of making it 100 per cent. by the old method, or the method now printed in the Manual, by taking into consideration the voids, we simply get a percentage of voids by the old method of possibly 10 or 15 per cent., or maybe more, which is added to the percentage, and the sum therefore becomes 140 or 130 per cent., which is very unsatisfactory in practice. Your committee investigated the methods of washing gravel by several of the gravel companies and selling it by contract, and it found the method being used by the contractors similar to this method recommended by the committee. It was almost impossible to explain to a contractor when complaining to him that he had too much sand, and when the sand was added to the gravel the sum equaled over 100 per cent. The contractor refused to believe the figures. The committee is not altogether satisfied with this formula in one sense, but it is by far the best that has been suggested.

Maurice Coburn (Vandalia): I would like to ask if the committee considered the question of measuring by weight?

Mr. Hale: Your committee did consider that and the variation due to moisture was so great that they abandoned it. The C. B. & Q. and the Santa Fe made quite a number of extensive tests by weight which were not satisfactory.

E. A. Hadley: I cannot agree with the chairman of the committee that the use of the percentage of voids in the ballast would go to make 140 per cent., as the percentage of voids properly used is a minus quantity, as the sand runs into the voids in the gravel, partially filling them, the same as the dust running into the voids in the sand, if properly used, the percentage would still equal 100.

Mr. Hale: Fifth paragraph. Some of these clauses seem rather unnecessary, possibly. The committee has had so much trouble in getting samples properly tested that they found every clause here very important. I would like to make a motion that the above method of testing quality of gravel for ballast be accepted and put in the Manual. (The motion was carried.)

Mr. Hale: The carrying of this motion automatically cancels one paragraph of the Manual, on page 150: "The above will necessitate the cancelling of the following paragraph, on page 49 of the Manual."

The President: If there is no objection, this will be done.

S. B. Rice (R. F. & P.): We have operated a ballast pit on the R. F. & P. branch, known as the Richmond-Washington line. It is immediately in the center of the road; it is 57 miles in either direction. We first started to handle this ballast as pit-run material. We had good results from it. We afterwards considered that we would get better track by having a washer. It was started in November, 1908. Since that time the entire line was reballasted with washed gravel, at a cost, in track finished, of less than 58 cents. The average loading was 8½ cents, washing 11½ cents, hauling 13½ cents, placing in track 24½ cents; total 58 cents. The extreme haul was 57 miles. There were cases where the loading was as low as 6 cents. The pit varied from 6 to 22 ft. in depth. Of course the deeper the cut the slower the loading. Of course the long and short hauls made a difference, the average in 400,000 yards—these were the average figures made up after three years' work. The track that was ballasted in 1908 is in good condition to-day. Of course it shows a little dirt from trains, but we have not had any bad joints. The track is in good condition. In regard to our maintenance, for the month of December, 1912, January and February of the present year, we had an average of $19.00 per mile per month, or an average of 63 cents per day per mile. We have 24 through passenger trains over our line. We are handling the Coast line and Seaboard trains, which are very heavy. We have an average of 22 freight trains. Our tonnage is from 10,000 to 12,000 tons per day. We think we have as good track with that washed ballast as we ever could get with any stone that could be furnished.

Prof. W. K. Hatt: In the formula at the end of the report the ratio is given and not per cent.

Mr. Hale: The committee will accept that suggestion.

BUILDINGS.

The following subjects were assigned to the committee by the Board of Direction:

(1) Present principles covering the design of inbound and outbound freight houses.

(2) Report on recommended methods of heating, lighting and sanitary provisions for medium-sized stations.

(3) Complete report on roof coverings.

(4) Report on the advantages and disadvantages of various types of freight house floor construction.

Progress is reported on subject (1).

Reports on (3) and (4) are presented herewith.

No recommendations are made as to revision of the manual.

ROOFING.

The following report on roofing combines the matter presented in the reports of the two past years, with some corrections and some additions.

The Bituminous Roofing Materials.

The bituminous roofing materials are varied and complex and what accurate knowledge there is about them is largely held by the experienced manufacturers. This is gradually being disseminated and the intelligent purchaser every year is able to buy with more confidence.

The bitumen substances are organic compounds, largely composed of many different hydrocarbons, with different chemical formulæ and widely-varying melting points. They vary so and the knowledge concerning them is so limited and new that considerable confusion exists in regard to nomenclature and classification. They are always accompanied by greater or less amounts of impurities, and are obtained either

naturally or as the heavier distillates or residues of coal, petroleum or other organic substances. Their distinguishing characteristics are their elasticity and binding power or adhesiveness, their considerable immunity from action by water and their solubility in oils and certain other organic compounds.

Asphalt.—The term asphalt is ordinarily considered as referring to bitumens found naturally in the solid state and will be so used in this discussion. These are obtained all over the world with widely-varying qualities. Mention will be made of those most important commercially in this country.

The asphalts are generally stable in the atmosphere. As found naturally, they are not commercially available, even after the impurities are removed, being too hard and brittle for most purposes. This is ordinarily remedied by softening or fluxing with various oils, an operation requiring skill. The character of the fluxes has a most important effect upon the finished product. Petroleum products are ordinarily depended on for this purpose. The fluxes should be sufficiently stable to insure against too rapid hardening of the fluxed asphalt. They should be free from deleterious constituents and should be of such a character that they will combine with the asphalt to be fluxed so as to make a homogenous and perfect solution. Certain fluxes which work well with certain asphalts are not at all suitable for use with other asphalts. Tars are sometimes employed for fluxing purposes, but they do not mix easily with the asphalt. As asphaltic compounds age they

MAURICE COBURN,
Chairman Committee on Buildings.

tend to become brittle and hard, losing their elasticity and binding power. Poor fluxing hastens this process.

Commercial refined asphalts, intelligently and honestly refined, should and do run very uniform. When they are compounded, however, brand names have very little significance and less value, and should not be taken in themselves as indicative of the character or value of the compound. Some types of asphaltic compounds properly prepared and used have qualities which make them almost indispensable for some classes of roofing.

Rock Asphalt or Mastic Rock.—Sandstone saturated with bitumen is found naturally in various places in the country, principally in California. It is sometimes known as mastic rock, and is more valuable for paving and floors than for roofing or waterproofing, where it is rarely used. There is also bitumen saturated limestone, of which that found in Uvalde County, Texas, is an example.

Petroleum Residuals.—The petroleums found in the United States vary in quality according to their location.

The Pennsylvania oils are rich in the paraffines and in the lighter and more valuable illuminating oils and naphthas. Most of the California oils are practically free from paraffines and have comparatively small quantities of the illuminating oils. They are darker in color, have a greater specific gravity and have what is known as an asphaltic base. The oils found in the intermediate fields have qualities varying between the two extremes in the order named.

Eastern oils are largely made up of compounds of the paraffine series, varying in consistency from comparatively thin oil to hard scale paraffine. While most of the paraffine compounds are useless as binding materials, many of the fluid paraffines are excellent solvents for certain asphalts and are in every way suitable for use as a flux.

The heavy residue from the distillation of the California oils is a substance with many of the desirable qualities of the best asphalts. The crude oil is distilled down to the required density and a product obtained with even and valuable qualities. Very large quantities of California oil asphalt have been used throughout the United States for paving and roofing purposes. It is probably true that more asphalt roofing felt has been saturated with California oil asphalt than with any other kind of asphalt. This oil asphalt when heated becomes very liquid at comparatively low temperatures, and, for this reason, is especially suitable for saturating felt.

The heavy residuals of the Gulf, Mid-Continent and Illinois petroleums are used in large quantities as substitutes for asphalts, frequently under that name. They are ordinarily less expensive than the natural asphalts. As compared with the California residuals, they contain more paraffine, are lower in ductility and adhesiveness and, except that some of the residuals of the Texas oils are very stable, are in most ways inferior for roofing. Sometimes they are used as adulterants with better materials.

To make them more stable and less affected by heat and cold, air is blown through them while hot. This reduces their ductility and adhesiveness as well as their susceptibility to temperature changes. Their use has in the past been limited by patents, but the original ones have expired and the validity of others is now before the courts. They are not as good saturants as an untreated residual, but for the protective coating of ready roofings they have considerable value, as they are stable and are not readily affected by the heat of the sun. They are not selected for stone-surfaced roofings because of their lack of adhesiveness.

The Tars.

Coal Tar—Coal tar contains some water, various impurities and free carbon which, after the water has been removed, is ordinarily from five to 35 per cent of the total. This is carbon formed by the cracking of the hydrocarbons and is in a very finely divided condition. The percentage varies with the method of manufacture. The distillates or bitumen are composed mainly of hydrocarbons which have widely varying melting points and degrees of volatility. These may be roughly classified into light oils, creosotes and pitches. The character of the tar varies with the coal used and the manner in which the process is carried on. The tar from each plant has its individual characteristics. The greater the heat, the more the hydrocarbons are cracked into their constituents and the greater the amount of free carbon and of gas found and the less the amount of coal tar.

The question of the relation between the free carbon and coal tar is one of considerable importance. It is generally considered to be a valuable adjunct to roofing tars and pitches. Free carbon makes the material less affected by changes in temperature. Comparing two pitches of similar consistency at normal temperatures, the one having the greater amount of free carbon must have to neutralize it a greater per cent of the lighter, more elastic and to some extent more volatile hydrocarbons and less of the heavy pitches. When it is cold the pitch is less brittle and when it is hot it does not flow so readily because of the carbon present. Thus a tar of given consistency may, notwithstanding the fact that it contains large quantities of an inert material, apparently have more life than another with less of the free carbon. To determine the probable action of any tar or pitch under different temperatures its percentage of free carbon must be known as well as its melting point. The free carbon in moderate amounts does not interfere with the saturating power in felt.

When coal tar pitch is exposed to the weather there is found upon its surface a thin layer, hard and brittle, the residue after the drying out of the volatile oils. This acts as a sort of protective coating to what is underneath. As soon as it is disturbed, exposing fresh pitch, the process is repeated. High carbon tars seem to weather better than low carbon.

Water Gas Tar—In the process which it undergoes the oil residues of water gas tars are so changed by the high heat as to lose many of their characteristics and to acquire some of those of the compounds found in coal tar. Compared with coal tar, its oils have less antiseptic properties.

Water gas tar contains some free carbon, but usually not over two per cent. Its pitch is not acted upon by water. There is a very general opinion among practical roofing men that the water gas tar products are less stable than the coal tar pitches, but we cannot find that there has been any accurate proof of this. Its small percentage of free carbon materially interferes with its value as a roofing pitch. It is said that carbon can be added, but we doubt the commercial practicability of such a scheme.

Oil tar decomposes more easily than coal tar. It often contains some paraffine, though ordinarily not in sufficient quantities to affect the product as compared with coal tar. The crude water gas tar is also much more affected by water and is capable to a considerable extent of forming an emulsion with it. Good coal tar is practically unaffected by water, and it deteriorates from the surface only.

We would sum up the remarks on the bituminous materials as follows:

With skill in compounding, based on a thorough working knowledge of the materials used, asphaltic compounds can be prepared of natural asphalts and oil residuals with valuable qualities for many different roofing needs, whose durability under known conditions can be foretold with considerable accuracy. The same can be said, perhaps with more certainty as to results, of the different tars. Either can suffer from adulteration and poor preparation. Considering first-class materials the coal tar is cheaper, more easily affected by temperature changes and is not acted upon by water nor is it liable to internal changes.

In order to meet the statements concerning the difficulties in getting, at the present time uniform straight run coal tar pitch of good quality, the leading manufacturer of coal tar is making arrangements with the Underwriters' Laboratories to make factory inspection of his labeled products. Preparations for this are being made in a thorough manner and competitors, to put their products in the same class, must also arrange for the same inspection. This, together with the specifications, enlarges considerably the possibility of being sure of getting good materials for a built-up coal tar roof.

Felts.

The felts used with almost all bituminous roofings play a very essential part in the final product. The desirable qualities of the felt vary with the saturating material to be used. With asphalt saturating power is the main desideratum. For coal tar, which under heat is much more liquid, this quality is not so necessary. All must be strong enough to avoid damage in handling before saturation. The strength of the finished product is due to a great extent to the saturation.

The felts are mainly made of rag stock, which is chiefly cotton rags. Notwithstanding the statements of many manufacturers, all-wool felt is never used for roofing, because of its expense and because it would be too soft and tender to work. A certain proportion of wool rags helps to make a felt which is open and spongy with considerable saturating power. Felts for saturation by asphalt rarely contain more than 25 per cent of wool. As ordinarily used the term wool felt applies to a soft open felt with very little wool in it.

Sometimes paper stock, which is ordinarily wood pulp, though it may contain an appreciable percentage of straw, is used in small quantities if the felt is getting too soft. It has practically no saturating power, but it can add to the cheapness of the material. If used in anything over two or three per cent, it is an adulterant to cheapen the product when it is made to sell to roofing manufacturers, or to make it less absorbent, as in the case of slaters' felt or hard felt for making up into two and three ply coal tar felt.

The dry felts are sold by weight. The standard is the amount which would lay 480 sq. ft. If a felt weighs 28 lbs. to 480 sq. ft., it is known as No. 28. For this reason felts sometimes have their weight increased by the addition of a mineral filler. This is nothing more than an adulterant which interferes with the saturating power. Some specifications which require a certain weight of felt get around such adulteration by requiring that the ash in the unsaturated felt must not exceed 5 per cent.

Felts of asbestos are used in one or two roofings. These are poor saturants and are more in the nature of protection to the asphalts. They will not burn or decay. Jute woven in the form of burlap or canvas is used in some roofings to add strength. Its value is debatable. It is not a saturant like the felts and its fibers are not so thoroughly protected, making it liable on exposure to rot. Burlap decays much more readily than the average cotton felt. The main use of tar for roofing has been in the construction of built-up roofs, where layers of felt saturated with tar are nailed down and by the use of a tar pitch protected and cemented together.

The following specification accompanied by the necessary diagrams give what is considered as good practice in the construction of a flat built-up roofing on wooden sheathing.

Specification for Felt, Pitch and Gravel or Slag Roofing Over Boards.

Incline.

This specification should not be used where roof incline exceeds three in. to one ft. For steeper inclines modified specifications are required.

Roofing.

First, lay one thickness of sheathing paper, or unsaturated felt, weighing not less than five lbs. per 100 sq. ft., lapping the sheets at least one in.

Second, lay two plies of tarred felt, weighing 14 to 16 lbs. per 100 sq. ft., lapping each sheet 17 in. over the preceding one, and nail as often as is necessary to hold in place until remaining felt is laid.

Third, coat the entire surface uniformly with straight run coal tar pitch.

Fourth, lay three plies of tarred felt, lapping each sheet 22 in. over the preceding one, mopping with pitch the full 22 in. on each sheet, so that in no place shall felt touch felt. Such nailing as is necessary shall be done so that all nails will be covered by not less than two plies of felt.

Fifth, spread over the entire surface a uniform coating of pitch, into which, while hot, imbed not less than 400 lbs. of gravel, or 300 lbs. of slag, to each 100 sq. ft. The gravel, or slag, shall be from ¼ to ⅝ in. in size, dry and free from dirt.

Flashing.

Flashings shall be constructed as shown in detailed drawings.

Labels.

All felt and pitch shall bear the manufacturer's label.

Inspection.

The roof may be inspected before the gravel or slag is applied by cutting a slit not less than three ft. long at right angles to the way the felt is laid.

N. B.—To comply with the above specifications, the material necessary for each 100 sq. ft. of roof is approximately as follows: 100 sq. ft. sheathing paper, 80 to 90 lbs. tarred felt, 120 to 160 lbs. straight run coal tar pitch, 400 lbs. gravel, or 300 lbs. slag.

In estimating felt, the average weight is practically 15 lbs. per 100 sq. ft., and about ten per cent extra is required for laps.

In estimating pitch, the weather conditions and expertness of the workmen will affect the amount necessary for the moppings, and to properly bed gravel or slag. The sheathing paper or unsaturated felt is placed on the bottom next to the roof boards, mainly to keep any pitch which might penetrate the two-ply felt above it from cementing the roofing to the sheathing. It also is of value in preventing the drying out of the roof through open joints from below.

To combat severe conditions encountered like those at locomotive engine houses, an asphalt or oil-saturated felt is sometimes used instead of the dry sheet. This does not so readily deteriorate. One roofer uses for this purpose asphalt asbestos sheets.

For a concrete roof the practice is similar except that a dry sheet is not necessary, there is no nailing and the concrete is first coated with pitch. Special care should be taken in regard to flashing and to prevent the roofing from being loosened at the edges either by wind or fire. Most leaks occur around flashings and openings.

The two layers of saturated felt first laid are necessary in order to carry and give full value to the amount of pitch which must be handled in one mopping. One of the troubles with built-up roofing as ordinarily laid is the difficulty in getting thorough moppings between the felt layers.

The felts are saturated with tar about as it comes from the gashouse, with the water and other impurities removed. Oil-tar with its liquid qualities is said to be much used for this purpose. This is more permissible than it would be if the felt were to be exposed.

The coating of gravel, crushed stone or slag helps to hold the pitch in place, protects it from wear and from the action of the elements and has considerable fire retardent value. If the material be too fine, its holding power is lessened. If it be too large, the stones are more apt to roll off and to damage the roof when it is walked upon and the pitch is not properly protected. Crushed material with its rough, sharp edges has a much better holding than rounded gravel. It can be used to help get results on a steep roof.

In the final coating of a coal tar roof the effort is to get the maximum amount of pitch coating which can be kept in place. The flatter the roof the greater the amount of pitch that can be used and the better both pitch and gravel will stay where put.

Where thorough inspection is not provided during construction the roof can be inspected by cutting a strip three feet long at right angles with the way the felt is laid before the gravel is applied. This can be readily repaired so that no damage is done to the roof.

When a built-up roof is in need of repair it can frequently be kept tight for a considerable time by patching and recoat-

ing, as may be necessary, with pitch and gravel. When the original roof was well laid it can be repaired by scraping off the coating of gravel and laying a new two or three ply roof on top.

Tile or brick can be substituted for the gravel or slag where the roof is liable to have much wear and when the structure warrants the expense. The tile are sometimes grouted in Portland cement, but a bituminous cement is usually considered better. Properly built, this makes almost an ideal roof.

The built-up coal tar roofs have shown by many years' trial their value for protecting flat roofs. Instances where a life of from 20 to 30 years has been obtained are not at all rare, but poor results due to poor workmanship and poor materials are not new. The claim that at the present time the ordinary purchaser cannot be sure of getting coal tar of the quality of the best of that formerly produced would seem to have justification. At the same time, the oil tar may be no worse than the fluxes and residuals frequently used with competing materials. Pure coal tar and coal tar pitch are still made, and the dealers in roofing materials can, if they desire, furnish materials as good as any which have been sold in the past. Such materials, of course, are not the cheapest and where competition is severe the quality is liable to suffer. About all that can now be done to get the desired results is to be willing to pay the price and trust to the dealers.

The chances for poor workmanship are many and the most thorough inspection is very desirable. The moppings between the felts can be slighted, the flashings and work around gutters and openings neglected, the materials may be adulterated on the work and the quantities of pitch and gravel cut down. The cost of materials and the cost of laying for any job can be estimated within close limits and no contracts should be let which will require a slighting of the work to avoid a loss.

As an indication of what can be done in territory adjacent to Chicago and St. Louis, the following figures may be of interest. They show actual costs on a roundhouse roof of about 500 squares laid according to the specifications given above. The work was 75 miles from the gravel supply and 175 miles from the headquarters of the contractor, who paid all freight and fare. This work was done in 1910 close to a railroad track, so that nothing was necessary for hauling to the work. Nothing is included for overhead or fixed charges or for profit.

Cost per square:	
5 lbs. sheathing paper	$ .12
155 lbs. pitch at 60c per cwt.	.93
85 lbs. felt to square at $1.65 per cwt.	1.40
Nails and caps	.05
Cleats for flashing	.05
Gravel (about one-seventh of a yard)	.23
Labor, including hauling, board, railroad fare.	1.15
	$3.93

Costs have been revised to show 1912 prices for materials.

Where, for temporary buildings or other causes, a cheaper roof than the standard specifications call for is desired, a saving in the quantities of material can be made by reducing the number of piles. From this fair results can be obtained.

Built-up Asphalt Roofing.—Built-up asphalt roofs have been used with considerable success. Asphalt is much less affected by temperature changes. For a roofing cement it must have considerable proportions of flux to make it easy of application. Coal tar felts are used with asphalt roofing cements. With asphalt, the dry sheet can ordinarily be avoided. Where first-class material is used it is ordinarily expensive and it is harder to handle. Except for steeper slopes than are suitable for coal tar, its use is not recommended unless unusual conditions make it more economical.

Asphalt coatings on a concrete deck are liable to lose their adhesion to the concrete. Asphalt used on a built-up roof is liable to have a short life and the builder of built-up roofs avoids it ordinarily. General specifications for an asphalt built-up roof cannot well be prepared because of the differences in materials, and ordinarily must come from the manufacturers of the materials.

Built-up Asbestos Roofing.—There are on the market materials for a built-up asbestos and asphalt roof. The asbestos felt is not as absorbent as are rag felts and acts more as a protection to the bitumens than as a saturant.

It is claimed that asbestos felt, acting as it does more as a protection to the layers of waterproofing material and not merely as a medium for carrying them, does not have any capillary action on the oil fluxes, and that the bitumen is so protected that it retains its elasticity and waterproofing qualities much longer than with the other types of felt. If this point is sustained, asbestos felts have a superiority for asphalt roofing over the ordinary felts which may more than overbalance the increased costs. While the experience obtained from this material is not nearly as extended as that which has been had from rag felts, these roofings have been in use for about eleven years, and we have so far found nothing to disprove this claim.

As compared with a five-ply tar and gravel roof, a four-ply asbestos roof will ordinarily cost at least from one to two dollars more a square. A three-ply roof is supposed to give good results over concrete, but for wood sheathing it would seem to be approaching too closely to the conditions met with in ready roofing, for first-class work.

This roof is ordinarily applied by the manufacturer.

Prepared or Ready Composition Roofings.

To compete with it and to meet some of the conditions where a built-up roof is not satisfactory or too expensive, innumerable prepared or ready roofings have been put on the market. These ordinarily come in rolls accompanied by the nails and cement necessary to apply them. They vary from a very light felt with the cheapest possible saturant and enough sand or soapstone coating to prevent sticking in the rolls, to a sheet so heavy that it cannot be rolled, built up of heavy felts and strengthening materials and saturated and protected by carefully prepared compounds, possibly protected also by a coating of crushed stone. The durability and fire-resisting value vary to as great a degree. Ordinarily the ready roofings are cheaper than any other types, but some brands sell at prices considerably above the cost of a good built-up roof. To a certain extent the weight is designated by the ply, but there is no uniformity of practice among the different manufacturers. A two-ply roofing may mean a heavier weight than a one-ply, or it may mean two separate felts stuck together.

The saturant should be liquid enough at workable temperatures to thoroughly impregnate the felt. The protective coating should be stable and not easily affected by the elements. The saturation of the felt is a very vital feature. This must retain its life and elasticity to keep the roofing efficient. A protective coating of material similar to the saturation is often used with the idea of helping to maintain the life of the saturating material. In any event, the coating must be elastic like the saturated felt.

With a coal-tar roofing made to be rolled, it is impossible to use nearly as much material as is found necessary for a good built-up roofing, and such a roofing, even if made in the very best manner, cannot be expected to have a life comparable with that of a first-class built-up roof. Tar is not considered the best material for a high-grade ready roofing.

Some ready roofings are adjusted by the manufacturer to suit the climate at the point of application. One concern selling all over the world keeps careful records of the temperature at its different markets and makes shipments accordingly.

The prepared roofings may be divided into two general classes—smooth and stone-surfaced. The stone-surfaced roofings are to a certain extent an adaptation of the built-up roofings. They frequently have at least two felts cemented together. The gravel or slag used must be uniform in size and finer than that available for a built-up roof. The steeper the roof the more chance they have to lose their stone coating. The amount of material that can be used in the heavier brands is limited to the amount that can be successfully rolled. If the stone is too large, the stone may damage the felt in rolling; if too small, the amount of pitch is limited.

The smooth-surfaced roofings are usually coated with some finely divided material to prevent sticking in the roll. Tar is not suitable for their protective coating. The protective coating must be stable and not easily affected by changes in temperature. Blown oils are frequently used for this purpose. The smooth-surfaced roofings, as a general proposition, have less insulating and fire-resisting value than the heavier stone-surfaced materials, and with them a regular recoating or painting is frequently necessary in order to get satisfactory results. This point and the chances of getting the necessary regular attention should be considered in making selections.

Tarred felts in which there are two or three plies of felts cemented together with pitch are sold all ready to be laid. at frequent intervals to show any value at all.
They must be covered with a tar coating upon laying and

The asbestos roofings are made to include one or more plies of asbestos felt, sometimes with a jute center. They are cemented together by asphaltic cements. In the heavier brands they are as expensive as a five-ply built-up tar and gravel roof. The asbestos felts are poor saturants. These roofings give promise of good results and are widely used. The asbestos will not burn, but the amount used is so small that its insulating value is not great, and the value of these roofings from the standpoint of fire protection is probably frequently overestimated.

Burlap or jute canvas is used in ready roofings as a strengthening material. It is not a good saturant and must

be kept thoroughly coated, as otherwise it goes to pieces readily. It is employed in conjunction with either felts or asbestos sheets. We question its value, feeling that better results can be obtained from a proper quantity of ordinary felt.

The ready roofing is weak in that with the narrow lap and a large part of the roof covered with but one layer of material a single defect can cause a leak. The fact that on a flat roof water is liable to back up under the upper layer is a chance for trouble.

One of the chances for trouble with many of the ready roofings is their tendency to stretch and wrinkle and the difficulty in laying them absolutely tight and flat. As the roofing grows older and brittle, the wrinkles become danger spots which are liable to crack if walked on. The roofing should be as thoroughly stretched as possible in laying. Knot holes should be covered before applying the roofing. In cold weather it is well to warm the rolls to avoid any chance of cracking.

The ready roofings usually commence to show deterioration after they have been kept in stock for three or four months. In purchasing care should be taken to avoid stock material.

The ready roofings are of value for small and isolated buildings, where the cost of laying a built-up roof would be excessive, and for temporary structures where a roof of long life is not necessary. They can be laid without the special workmen usually considered necessary for built-up roofing, but careful workmanship and skill are necessary to get good results.

Most brands can be used on any slopes, but on a flat roof extra precautions are needed to avoid leaks, and on a steep roof some kinds do not do well. On steep roofs trouble from bagging is avoided by laying the strips vertically instead of horizontally. They can be obtained at almost any desired price, but ordinarily cheaper than a good built-up, coal-tar roof.

So many inferior roofings have been sold, so many have been poorly laid or used in the wrong places, so much has had to be learned by bitter experience, and there is such a chance for fraud, that the ready roofings are shunned altogether by many builders who want good results. But experience is being gained gradually, and they fill many needs so well that their use is bound to increase in their proper field.

Most of the ready roofings are sold under a five or ten years' guarantee, and many contracts for built-up roofs are similarly prepared. To depend upon these guarantees alone does not give satisfactory results, even though the manufacturer be financially responsible. He can expect more immediate profit by preparing a roof which he is sure will last six or seven years and selling it under a ten years' guarantee than by preparing a roof which he is sure will last for ten years.

New and untried brands are constantly being put on the market. In some of the older ones, which have gained a reputation, inferior products are substituted. Many of the best ready roofings are made of compounds whose composition is kept secret. The only way now of being fairly sure of good results is to use a brand which has been shown by long tests to meet the desired conditions and which is made by a concern with a reputation for fair dealing. The same course would seem to be desirable in the awarding of contracts for built-up roofs, though with them track can be kept of the weight of material used and the work on the roof can be inspected.

This is not a satisfactory condition, and, as indicated in the earlier part of the report, it is hoped that before many years specifications can be devised, which, coupled with the necessary tests and with efficient factory inspection, such as that the Underwriters' Laboratories is furnishing for some materials, which is explained below, will do away with the ignorance and fraud now too often met with in the bituminous roofing industry. We should then be able to buy roofing with as much certainty of quality as we can now expect in ordering steel rail. To this end our Association, working in conjunction with other organizations, should do its part.

Tile.

The term tile roofing is ordinarily considered as referring to roofing made of hard burned clay tile made with overlapping or interlocking edges.

Originally the cost of tile was more than slate, but at the present time the price of ordinary patterns is about the same as for a good quality of slate.

Besides the interlocking tile, clay shingles are made which are laid like slate and give about the same results as slate.

With tile it is a little harder to get a tight roof than with slate. Tile should not be used on a roof having a less pitch than one-quarter, and a steeper roof is preferable. With them, as with slate, the less the chance for driving snow the flatter the allowable pitch, and for this reason in the South the use of tile can be more extensive than in the North.

Where there is a chance of driving snow, it is best to make a water-tight roof of prepared roofing, preferably a thirty-pound or heavier asphalt felt laid horizontally with well-lapped, cemented and nailed joints, as with slate. Sometimes the tile are imbedded in asphalt or coal tar pitch, but this method does not insure the best results. The waterproofing felt is better and cheaper.

It is usual to apply the tile directly over the asphalt roofing felt with heavy nails. They are sometimes fastened with copper wires from a pierced lug toward the lower end of the tile. The wire is fastened to battens nailed horizontally on top of vertically laid battens or laths and fastened on by wire. Copper wire not less than No. 12 gage should be used for this purpose. Steel wire or bands corrode quickly.

Sometimes the tile are laid directly on steel or wooden purlins, which must be placed to suit the lengths of the tile, with the omission of roofing boards and felt. This construction is objectionable when the building is to be heated, but is suitable where escape of heat through the roof is desired or not objectionable and where an absolutely waterproof roof is not necessary. When so laid, to prevent the entrance of dust or dry snow, the joints may be pointed on the under side after laying with elastic cement.

Some manufacturers of roofing tile make glass tile of the same pattern as the clay tile, so that they may be worked in with them and used in place of skylights. These glass tiles have been used on the roofs of train sheds, shops and factories.

Hips, valleys and combs of tile roof are formed of special designs for that purpose.

Roofing tiles weigh from 750 to 1,200 pounds per square.

It is a little harder to get a tight roof with tile than with slate. If there is any difference, the tile roof is liable to cost a little more. Tile better withstands great heat, contains more material and is so laid as to have more insulating value than slate. Properly made, it does not deteriorate through the action of the elements. It is a poor conductor of heat and cold. It is not so brittle as ordinary slate and is less liable to be damaged by settlement of the roof. Tile, with the possible variations in color and shades, can be better varied to meet the architectural requirements of the building. With the improvements in the manufacture of clay roofing tile, it would seem that its importance will be gradually increased.

Slate.

Slate comes with considerably varying qualities. It should be hard and tough and have a well-defined vein, which must not be too coarse. If too soft it will absorb moisture; if too brittle it cannot be cut and punched without splitting, and it will easily be damaged by walking on the roof. Crystals are sometimes found which disintegrate on exposure to the weather. Acid gases in the air and freezing of absorbed water tend to cause a disintegration of the slate.

The surface when freshly split should have a bright, metallic luster, be free from all loose flakes or dull surfaces, and be straight and true. Most slates contain ribbons or seams which traverse the slate in approximately parallel directions. Slates containing soft ribbons are inferior and should not be used in good work. Hard ribbons do not necessarily indicate inferior wearing quality. A clear, metallic ring when struck is an indication of soundness. A cracked slate gives a different sound, easily distinguishable. A soft slate gives a dull, muffled sound.

The color varies widely, but does not necessarily indicate the quality. Good, unfading black slate can be obtained. Some of the black slates fade rapidly on exposure to the atmosphere, assuming colors considerably varied. Various shades of green, red and gray may be purchased, some of which retain their original color very well. Some slates are marked with bands or patches of a different color, and the dark purple slates often have large spots of light green upon them. These spots do not, as a rule, affect the durability of the slate. Black ribbon slate may be obtained at less cost than strictly all black slate, and is suitable where slight variation in color is not objectionable.

Stock sizes of slate range from 7 in. x 9 in. to 14 in. x 24 in. They vary in thickness from 1/8 to 3/8 in. Three-sixteenths inch is the usual thickness for ordinary sizes. For large plain roofs the larger sizes, such as 12x16, 12x18 or 12x20, are best adapted. They break a little easier, but make fewer joints in the roof, require fewer nails and better avoid small pieces at hips and valleys. For roofs cut into small sections, the smaller sizes, 7x14 or 8x16, look better.

Slate should not be laid on a roof having less than one-quarter pitch. Where the roof is flatter than one-quarter pitch, it is liable to leak from capillary attraction. Finely

powdered snow driven under the slate by a high wind, later on melting and freezing, is liable to cause damage to a roof.

The best practice is to lay slate on wooden sheathing, tongued and grooved to an even thickness, and covered with a waterproof paper or felt to act as a bed and as an insulating medium. Tarred products should not be used, but a felt saturated with asphalt and weighing 30 lbs. or more is preferable.

Each course of slate should lap the slate in the second course below three inches, although this can be slightly cut down on the steeper roofs. In laying care should be taken to avoid cracking the slate by driving nails carelessly or too tightly.

The slates are fastened with two four-penny nails, one near each upper corner. The nails should have large, flat heads, so that they may get a good hold on the surface of the slate, and their length should be twice the thickness of the slate, plus the thickness of the sheathing. Three-penny nails are one and one-eighth and four-penny nails one and three-eighths inches long. Composition nails should ordinarily be used for railroad buildings.

Slate roofs rank well in regard to fire hazard, although they are not as good as tile on exposure to adjacent conflagrations.

Cement Roofings.

Reinforced concrete tile, several square feet in area, have been used to a considerable extent on shop buildings and freight houses with steel roof trusses. They are usually formed with projections, so that they can be placed directly on the purlins and held in place by their own weight, without additional fastenings. Wire glass can be successfully inserted in these tiles, thus avoiding expensive skylight construction. Their cost compares favorably with that of slate. The reports from them are good; but, unless the roof framing is stable and even, there would seem to be danger of leaks from driving rain and snow.

Small cement tile are in use to a limited extent and the criticism given concerning the reinforced tile also applies to them. They are less expensive than clay tile, but are more absorbent and brittle. Improved methods of manufacture and further tests may later develop their merits for some purposes, but no economy has so far been shown by their use.

Asbestos sheets made of Portland cement and asbestos under pressure give promise of good results. They can be made in different colors and have some desirable features. The different manufacturers use different methods and the results obtained must be used with caution, as it is claimed that the methods of manufacture have an important bearing on the results which may be expected.

For small buildings, or where the design is such as to make tile undesirable, they have especial advantages. Their cost is somewhat greater than good slate, but their uniformity is such that they can more successfully be laid French or diagonal method than can slate. A considerable saving can be made by laying them French method, but we do not consider this good practice with large sheets. The material is somewhat brittle, and with this method considerably greater amounts of breakage are to be expected, especially on the points.

The corrugated sheets should have value as a substitute for corrugated iron sheets. They must be laid with good fastenings and sufficient lap to insure against leakage. Some of these materials are strengthened by wire mesh and some with perforated steel sheets, giving a product grading toward the metal protected by asphalt and asbestos.

Shingles.

A wood shingle roof, properly laid and of good material, will last many years. The old clear white pine shingles, formerly obtainable, were superior to anything now on the market, but red cedar shingles of good quality can be obtained from the Pacific Coast. In the South red cypress from the Gulf States is preferable.

The main objection to a shingle roof is its fire hazard. When the roof is old, especially in a dry climate, shingles crack and get out of shape, providing a place for the lodgement of sparks and materially increasing the danger from fire hazard.

There should be two, and only two, nails for each shingle. If more are used the shingles will crack. They should not be laid too close together when dry, or they will tend to buckle when wet.

Metallic Roofings.

Metallic roofings may be laid in large sheets sometimes without any sheathing. These sheets are often strengthened by corrugating them. They are sometimes cut up into small sheets and laid as are shingles. Sometimes they are bent into interlocking shapes like clay tiles. The first cost of these tiles, except those of copper, is much less than that of clay tiles, and they do not require as heavy roof framing.

They are also soldered together on the roof into a single structure, of which the ordinary tin roof is typical. Copper, lead, Monel metal and tin are used this way. This type is especially valuable for flat roofs.

Iron or Steel.

Iron and steel are largely used as a basis for metallic roofings because of their strength and cheapness. Their corrosion, especially for railroad buildings, is the most important factor in connection with their use as roofing materials.

This question of the corrosion of iron and steel is a live one, but the following conclusions seem to be accepted by the best authorities:

The rate of corrosion depends much less upon the amount of impurities present than upon their distribution in the metal. Segregation, strain, or anything which causes differences in electric potential, hastens corrosion. Mill scale is a very important factor, causing pitting. The better results often obtained from wrought iron as compared with steel are due mainly to the greater homogeneity of the iron. Good wrought iron is not appreciably better than good homogeneous steel.

There are some elements like sulphur which, when present in steel, tend to hasten corrosion and some, like copper, nickel and silicon, tend to retard it. An absolutely pure iron in use on a building would not show results appreciably different from a high-grade steel, and with mill scale or internal strain might do much worse. Accelerated acid tests are not a fair index of the value of metals for roofing purposes. Part of the dissatisfaction with steel in recent years is due to the thin sections used. Cast iron is protected by a silicious skin formed from contact with the mold at the time of casting and it is used in thick sections.

Where two sheets of different manufacture come together on a roof galvanic action and corrosion are liable.

Iron or steel may be used unprotected except by paint. This, of course, requires regular attention and unless access can be had to all the exposed metal satisfactory results cannot be had. Galvanizing, or coating with zinc, if properly done, gives excellent results.

One method employed in the preparation of steel for roofing purposes is to pickle the steel in acid baths to cleanse the sheets of scale and dirt. Unless this process is most carefully followed by thorough cleansing, minute particles of acid remain to form within the plate itself an agent for its final destruction. This may occur either with tin plate or galvanized iron.

Asbestos-protected metal is sheet steel covered with a coating of bitumen and asbestos. It has not been long enough in general use to show just what place it should hold. Commercial tin or terne plate is iron or steel coated with an alloy of lead and tin. About 75 per cent. of lead is a common percentage.

Tin Plate.

When tin is specified, the coating should consist of not less than 30 per cent. pure tin nor more than 70 per cent. pure lead. Not less than 20 lbs. of the coating should be used per box of 112 sheets 14 in. by 20 in. A great deal of very poor coating has been put on the market by the manufacturers of tin roofing material. Good tin plate for roofing can be had, and where it is desired to use this material for roof covering, one of the reliable brands of hand-dipped plate, not less than IX or No. 28 gage, should be selected. Rolled tin plate should not be used for roofing, guttering or valleys.

Tin roofing must be painted with a good paint to preserve it. Tin roofings can be shown which have laster 20 or 30 years on railroad structures, but the danger of securing poor material and the cost of maintenance have made conservative builders very cautious in its use. It has the great advantage of being available for all slopes and it is adaptable to special and difficult conditions.

Gutters.

Gutters for many classes of railway buildings may and should be omitted. This is more particularly true of buildings with steep roofs near tracks, where cinders from passing locomotives roll down the roof into the gutters and in time, unless more care is taken to keep them clean than is usual in railway buildings, the downspouts become choked and fail to carry off the water.

Gutters may be of metal, wood, or be formed in roof of the materials used in the construction of the roof, the latter being ordinarily preferable where the design of the building permits.

Flashing.

A large part of the trouble with roofing comes from leaks due to poor flashing around the edges, at gutters, parapet walls and openings. Provision must be made for expansion

and contraction, due to heat and cold, to loading and settlement and to shrinkage. It must be used far enough back to prevent any possible backing up of water. It is advisable to use as little metal as possible. Special care must be used in working up against parapet walls, as with two kinds of material this is difficult, special terra cotta block to insert in the parapet wall and give a point of application for the roofing material is on the market. It is valuable and would be more used were it not for the trouble in getting this special material on the ground unbroken and in getting it properly set in the wall. On a composition roofing the edges should be cut off to a straight line and project over above the gutter. For a built-up roof a metal gravel stop is desirable. Where no other metal work is used, a wood strip is used. For concrete the edge of the roof should be provided with a wooden nailing strip fastened by a bolt inserted into the concrete.

Conclusions.

The committee recommends the substitution for the last conclusion in the manual under roofing (reading as follows: "Steel or impure iron materials should be avoided, no matter how protected") of the following:

The various metallic roofings have an important place among the roofing materials. Care must be taken to have them properly used and protected.

In using iron or steel for roofing purposes every effort should be made to get a metal of best quality.

The roofings using Portland cement, either with re-enforced concrete or with asbestos, have value under the proper conditions.

FREIGHT HOUSE FLOORS.

Freight house floors should ordinarily be built to carry a uniformly distributed load of at least 250 lbs. per sq. ft. They should be of materials which will not in any way damage any articles placed upon them, which will provide a surface smooth and durable, and be so constructed that they can be easily repaired. Except for small houses, a filled-in floor, considering the cost of maintenance, is ordinarily cheaper than joist construction. It is also advantageous, because it will carry the unusually heavy loads that sometimes occur.

The usual method of construction consists of filling up to the required level with sand or gravel, thoroughly flushed and compacted. To insure a dry floor, a bed of cinders about six inches thick, thoroughly compacted, on this filling is laid. In the cinders are bedded sleepers, preferably about 4 in. x 6 in., laid flat, about two ft. six in. centers. These and the plank above them should be thoroughly treated with creosote or zinc chloride, where there is to be an additional wearing surface applied. With untreated timber renewal is sometimes necessary within four years, though under favorable conditions a life considerably greater is usually obtained. When no cinders are used on top of the sand the decay seems to be hastened.

In place of cinder filling and sleepers a layer of coal tar pitch spread upon a layer of sand over a course of concrete is being quite extensively used. This is durable and is said to give good results. Specifications for this method are obtainable from the coal tar producers. Either on the sleepers, laid in cinders, or on the pitch are laid planks about two inches thick. With the pitch sub-floor the plank should be laid with broken joints, toe nailed, and imbedded in the pitch by hammering until the proper stability is obtained. Care should be taken to see that they are brought to an exact grade. The plank need not necessarily be toe-nailed with the wooden sleepers.

To get a smooth-wearing surface on top of the plank, hard maple is generally preferable. It does not splinter and it wears evenly. It has a short life when exposed to the weather. It is growing scarce and getting expensive. Beech is often sold for maple, they being difficult to distinguish. It is somewhat darker in color and it splinters more. Birch is softer than beech or hard maple, but does not splinter so readily as beech.

Gum, especially tupelo, is recommended as a substitute for maple and it probably will, to some extent, displace it. It is darker in color and somewhat softer, but it wears evenly and it does not splinter much more than maple. Thorough seasoning is particularly essential. There is a large supply of gum in the South and its use for floors should be extensive.

Under most conditions, the best floor can be had by laying the top floor diagonally, putting the plank lengthwise and the sleepers crosswise of the house, without any bearing on the side walls. Inequalities in settlement of the floor are then less liable to make trouble, the plank can be laid with minimum expense, and the top floor gives the best results after considerable wear. This costs for the top slightly more for laying and more for repairs. Where there is a pronounced amount of trucking in one route, it is sometimes thought desirable to put the flooring parallel to this trucking, but where the amount of traffic warrants it would seem best to put a runway of steel plates.

Wood block pavements may be used in place of the board floor. They are best used on top of a concrete sub-floor, with a one-in. sand cushion between. With wood blocks care should be taken to obtain sufficient expansion joints, as many floors have failed from a lack of this precaution. One in. for 50 ft. is about the correct amount. Care should also be taken to avoid the use of creosoted blocks where flour or similar articles which are easily damaged by odors are handled. There is also a chance of such damage from tar used in the expansion joints. Zinc chloride is for this reason recommended as a preservative for wood blocks when used for freight house floors. Zinc chloride is cheaper than creosote, and in a freight house the blocks will not suffer from the leaching which takes place when they are exposed to the weather, the main objection to the use of zinc chloride for treatment of crossties and paving blocks. It is almost impossible to get this kind of floor as smooth as a maple floor, but if properly laid it tends to wear smooth. It is adapted to points where wear is especially severe, such as are due to the handling of castings and heavy machinery. Its main advantages are in the ease with which it can be repaired. The blocks are ordinarily made of pine. It would seem that gum blocks would be better. Maple blocks are also used, but are expensive.

Concrete has been used successfully where the wear is not too severe. There is chance of damage by falling freight, and its use must be restricted to places where there is little chance of castings and similar articles being handled, unless the top surface is carefully made of the best of hard aggregates. Under such conditions excellent results have been obtained.

A concrete sub-floor protected by a layer of asphalt mastic will give excellent results. It will cost more than the concrete floor, but it will not chip and scars made in its surface soon disappear. It is not so cold as the concrete floor and has been used for this purpose with success. Asphalt blocks properly made would seem to have some advantage for this purpose. They should make a smoother floor than the wood blocks and be easier repaired than the mastic floor.

Maurice Coburn, Vandalia, chairman; M. A. Long (B. & O.), vice-chairman; G. W. Andrews (B. & O.), J. B. Canty (B. & M.), O. P. Chamberlain (C. & I. W.), D. R. Collin (N. Y. C. & H. R.), C. G. Delo (C. G. W.), W. T. Dorrance (Me. Cent.), C. H. Fake (M. R. & B. T.), C. F. W. Felt (A. T. & S. F.), W. H. Finley (C. & N. W.), G. H. Gilbert (Q. & C.), A. T. Hawk (C. R. I. & P.), H. A. Lloyd (Erie), L. G. Morphy (B. & A.), C. W. Richey (P. R. R.), W. S. Thompson (P. R. R.), committee.

Discussion on Buildings.

Mr. Coburn: We would like first to consider the report on freight house floors. In going over this report and attempting to make conclusions for the Manual, it was decided that we would ask that this entire report on freight house floors be printed in the Manual.

Mr. Lindsay: I would like to call attention to the first paragraph, and to the new development that has given rise to some question in our minds as to the permissible load per square foot, and that is the use of electric trucks in freight houses, transfer stations and so forth, and the heavy loads that will result therefrom. We have a new freight house that was designed for 250 lbs. loading per square foot, and since then we have adopted the electric truck, with very heavy loads. I do not advocate increasing that at all, but I call your attention to the fact that it is coming and we must prepare for it.

Mr. Coburn: The committee will be pleased to insert in this report a paragraph stating that where there is any possibility of using this, that matter should be considered. It seems to me that should be a part of this report.

(The report on freight house floors was accepted.)

The President: The report on roofing was adopted, with the understanding that the committee will co-operate with the Committee on Publications and the proper material will be put in the Manual. The conclusions were also adopted for publication in the Manual.

WATER SERVICE.

The Board of Directors assigned the following subjects to the committee:

(1) Report on the design and relative economy of track pans from an operating standpoint.

(2) Report on the design of water stations using deep well pumps as source of supply.

(3) Report on recent developments in pumping machinery.

THE DESIGN AND RELATIVE ECONOMY OF TRACK PANS FROM AN OPERATING STANDPOINT.

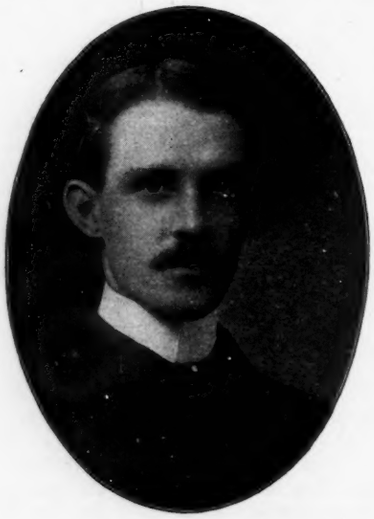
The committee asks for further time in which to make a final report on this subject.

DESIGN OF WATER STATIONS USING DEEP WELL PUMPS AS SOURCE OF SUPPLY.

The committee felt that a study of deep well pumps would cover the vital subject in the design of deep well pumping stations and submits a report which outlines the various types of deep well pumps and the conditions favorable to their use. The committee believes that most of the members are familiar with the ordinary single-stroke steam deep well pumps, but are not acquainted with other types and with conditions essential to satisfactory operation. It was desired to submit data on efficiency, but this was found lacking. It may be possible that tests and further report can be made later. The report will serve, however, to inform the Association in a general way and probably to insure against improper installations, and it is hereinafter submitted as information.

REPORT ON RECENT DEVELOPMENTS IN PUMPING MACHINERY.

Report progress. The subjects under consideration are: internal combustion engines, centrifugal pumps and turbines



ROBERT FERRIDAY,
Chairman Committee on Water Service.

and the use of electric power for water stations. The latter subject is thought timely in view of the availability of that power which is rapidly spreading through the construction of interurban roads paralleling steam roads.

WATER TREATMENT.

Report progress. A study is being made of water softeners from an operating standpoint.

Deep Well Pumps.

In this report a deep well is assumed to be a well usually of small diameter, in which the water does not stand within economical suction limits of the ordinary surface pump, or one in which the drop or draft with the desired yield brings the surface of the well water beyond an economical reach. This condition makes necessary the separation of the water end and the power end of the ordinary pump, the former being depressed into the well either to a point of submergence or within easy suction reach of the water during all its stages and the latter being placed on the surface of the ground within easy access of the boiler or other source of power. This arrangement has given rise to various devices known as "Deep well pumps."

Deep well pumps are of many varieties, but without attempting to include the many special devices for lifting deep ground water, those generally used with success in railway practice can be classified under the following heads: reciprocating, displacement or plunger pumps; centrifugal pumps, propeller pumps, air lifts and air displacement pumps.

Reciprocating, Displacement or Plunger Pumps.

The old-fashioned domestic, or yard pump, is of the first class. In this type the working barrel or cylinder is depressed in the well, either to a point of submergence, or within easy suction reach of the water, and the piston is connected with a power head located on the surface of the ground by means of a set of jointed rods of convenient length. The source of power may be either steam applied directly to the upper end of the rod as in a direct acting steam head, or a geared or belted power working head may be used.

This type of pump may have either a single-acting working barrel, in which water is discharged on the upstroke only of the piston; or double-acting, in which there are two pistons, one above the other in the same cylinder, operated by separate rods, working in opposite directions. One of the rods is a pipe and the other an inside solid rod. The inside rod is connected to the lower piston and the hollow rod to the upper. There is also on the market a double-acting type of displacement plunger pump having a single rod and a system of valves in the barrel so designed that water is discharged on both the upstroke and the downstroke of the plunger.

Of the double-acting pumps operated by double rods there are two types. In the first, the two plungers come to rest at the same time, one at the upper and the other at the lower end of the stroke, which results in an intermittent flow. The other type, called "constant flow" or "non-pulsating" pumps, are operated on the same principle as the quick-return mechanism used on shop machinery. About 53 per cent of the revolution of each plunger is spent in the upstroke and about 47 per cent on the downstroke. The plungers therefore come up more slowly than they go down, with the result that the first plunger has completed its downstroke and has picked up the load before the other plunger has come to rest at the end of the upstroke. In other words, one plunger is always lifting, and the column of water which does not come to rest as in the ordinary type of plunger has a constant and practically uniform flow.

Centrifugal Pumps.

There has recently come into use a vertical shaft, high speed, centrifugal pump of a diameter small enough to be lowered into a well of small bore to a point of submergence or within suction reach of the water in the well. The pump can be operated by a direct connected electric motor, steam turbine or with a belt drive having a quarter twist. The last arrangement will be found less desirable than the other two, as it is rather cumbersome for a permanent railway installation. Either single stage centrifugals, or multiple stage, where the lift makes it necessary, are suitable for the purpose. They are usually made for pumping water from wells whose diameter to the water level is twelve inches or larger, and a flexible connection between the motor and vertical shaft is generally used.

Propeller Pumps.

In this device, which is a modification of the old screw-pump, the power head is attached directly to the well casing and carries a vertical shaft that extends to a point of submergence in the well, both before and during the pumping. Propellers are placed on the shaft at regular intervals of about five feet. One propeller at least must be always submerged. Each propeller is usually provided with a stationary surrounding shield that protects the well casing against injury from the rapidly revolving propeller and also serves to center the shafting. The shields are usually riveted to several flat vertical spacing bars which form a caging to enclose the shaft and propellers.

Either a direct-connected vertical motor with a flexible coupling is attached to the power head or a yoke is provided to receive a pulley attached directly to the shafting. In the latter case, the pump is operated by a quarter-twist belt from a steam engine or other source of power.

This pump was first designed to discharge the water at the surface of the ground only, but there has recently been developed a combined turbine and propeller pump that will discharge against pressure, or, in other words, lift water above the level of the power head. The turbine is placed in alignment with the power head and propeller sections and the whole forms a concentric unit that will discharge water to the desired height above the pump head.

Air Lifts.

Opinions as to the true theory of the air lift differ widely, but it is generally accepted that its principle is that of a column of intermingled air and water in a vertical discharge pipe being lighter than the outside column of ground water, giving rise to a lack of equilibrium in the well, and resulting in the mixed air and water rising in the discharge pipe

and overflowing at the top. The air lift consists essentially of a discharge pipe, of which the well casing may or may not form a part, and an air pipe which leads the compressed air into the bottom of the discharge pipe. Many forms of nozzles for the end of the air pipe are in use, but experience has shown that an open air pipe pointing downward is fully as efficient as any other form. The air pipe may be inside or outside the discharge pipe and the pressure of the air need only be slightly in excess of the pressure resulting from the static head of the water at the point of air admission. The distance from the water surface in the well to the point in the discharge pipe at which the air is admitted is called the submergence. Experience has shown that for unexplained reasons best results are obtained when the submergence, while pumping, is about 60 per cent. of the total distance between the point of air admission and the point of water discharge at the top. With greater or less submergence the efficiency of the air lift has been shown experimentally to rapidly decrease.

The diameter of the air and discharge pipes must be properly related to the quantity of water to be delivered in order to avoid undue resistance and loss of efficiency. A discharge pipe with a sectional area so large that the velocity of the water exclusive of the entrained air falls below four feet seems to permit the air to escape through the water with great loss of efficiency, while a discharge pipe of so limited area that velocities over six feet are attained also causes decreased efficiency, probably due, at least in part, to friction resistances. Experiments conducted in San Francisco in 1890 indicate that the highest efficiency is obtained when the velocity in the discharge pipe is about 4 to 6 ft. for the net volume of water discharged, not including the mass of intermingled air.

In Turneaure & Russell's "Public Water Supplies," the formula given as "commonly used for determining the relation of the various factors in an air lift problem" is—

$$q = \frac{125\,A}{h}$$

in which q = gallons of water per minute.
A = cu. feet of free air per minute.
h = height of lift in feet from water surface to point of discharge.

Air Displacement Pumps.

In this device for raising ground water, the air acts as a piston upon the upper surface of the water in a discharge chamber, depressing it to a given level and discharging it through an eduction pipe to the desired point. In wells of small bore the discharge chamber consists of a vertical pipe or barrel to which is connected the air pipe at the upper end and the discharge pipe at the lower end. The discharge chamber fills either by gravity or by suction. The air is admitted by a reversing valve that is actuated either by trip valves located in the discharge chamber, which in turn are operated by floats when the water has reached a predetermined level; or by the increase and decrease of pressure in the air line due to the rise and depression of the water surface in the discharge chamber.

In some types the air is exhausted into the atmosphere, while in others it is led back to the suction of the compressor under gradually diminishing pressure. The water flows into the discharge chamber by gravity as the air is displaced, and if the compressor forms a partial vacuum the discharge chamber will be filled by suction to a level above that of the water in the well.

In wells of large bore, two discharge chambers are sometimes placed side by side, from which the discharge takes place alternately with a practically constant flow. The same result is accomplished by connecting two or more wells with the same delivery pipe and the same reversing valve which admits air into the several discharge chambers alternately.

Conditions Governing Selection of Type and Efficiency.

It is beyond question that all the devices for raising deep ground water described have their particular field of usefulness. The intermittent flow plunger pumps undoubtedly have a low efficiency. In both the single and double-acting types the column of water in the vertical discharge pipe comes to rest at the end of each stroke. The shock of overcoming the inertia of the column of water at the beginning of every stroke is necessarily violent and leads to great loss of power. The speed is limited to about 100 ft. of piston travel per minute to prevent undue injury to the mechanism, and this limits the yield of the well to the actual displacement capacity of the pump at this speed. In the "constant flow" or "non-pulsating" type, much higher speeds are practicable and the loss of efficiency due to the violent shock of stopping and starting the column of water is largely overcome.

Where the desired output is small and the lift is relatively low, the reciprocating pump undoubtedly has a wide field of usefulness. The first cost of installation is relatively small and the interest and depreciation charges are therefore correspondingly low. At water stations having a small output the fuel consumption, which is the factor most influenced by low efficiency, is a small part of the total cost of operation; the greater part of the operating cost usually represents the attendance and the interest and depreciation charges. However, this pump is simple and reliable and is giving good results where the yield per well or the desired quantity is small. The output can be increased approximately 100 per cent. by the use of the double-acting type as compared with the single-acting, with some increase in first cost. High efficiencies are shown by the "non-pulsating" type and an increased yield is obtained on account of the higher practicable speeds. A test made by the Engineering Experiment Station at the University of Illinois with a motor-driven pump of the "non-pulsating" type showed an overall efficiency for motor and pump of 47.7 to 49.2 per cent. Subsequent experiments indicated that the efficiency of the motor was about 70 per cent. and the pump efficiency was therefore also about 70 per cent., which is unusually high.

The reciprocating plunger pump does not lend itself well for operating scattered wells unless electric power is available. The maintenance of separate steam plants is impracticable, and where the character of the water-bearing formation requires a wide spacing of wells for good results, the loss in steam transmission is necessarily large. Such wells, however, may be located in a straight line and be operated from a single shaft, or may be located at random and operated by the device familiar in oil-producing territory, a description of such plant for a water station being given in the 1911 proceedings.

Where the yield per well is large and large quantities are desired at a constant rate, pumps of the centrifugal and propeller types offer particular advantages. Units of this type are simple and compact, and their output is perhaps larger than that of any other device for raising deep ground water except the air lift. Relatively high efficiencies result where the type and design selected are made to fit the quantity of discharge, lift and other conditions of service. Where electricity is available scattered pumps of this type can be operated by individual motors at a minimum expense for supervision. This pump also possesses the particular advantage of successfully handling waters that contain considerable sand, which in the reciprocating pump will soon destroy the wearing parts of the working barrel, but its use in wells that are not straight is not successful on account of the necessary bending and distortion of the shaft with every revolution. The maximum practical length of vertical shaft does not usually exceed 200 feet.

Air Lift and Air Displacement Pumps.

The air lift is not an efficient device, but it is capable of raising a larger amount of water from a small hole than any other deep well pumping method. The comparatively poor method of power application and many energy transformations can only result in limited efficiencies. However, it lends itself very well to serve scattered wells from one central power station, provided the spacing of wells is not so large as to result in excessive cost for piping the air supply. Its principal objections are the low efficiency and the disadvantage of providing the necessary submergence for best results, which under certain conditions is impracticable. The efficiency falls off so rapidly with a submergence decreasing below 60 per cent. that any wide departure from this submergence renders the loss of energy practically prohibitive. In the air displacement pump a fixed submergence for good results is not required, as it is only necessary to have the discharge chamber sufficiently submerged to insure its filling by gravity or by suction.

The air lift offers particular advantages in handling wells that contain considerable sand, as there are no valves to be affected, also in operating wells that are so crooked that the ordinary pump rod or vertical shaft cannot be used and in holes of too small bore for other methods, but unless the wells are located in the immediate vicinity of the tank, a second pump is necessary to elevate the water into the tank, as the air lift will not convey water horizontally, which, however, is true only of the air lift and not the air displacement pump.

Robert Ferriday (C. C. C. & St. L.), chairman; J. L. Campbell (E. P. & S. W.), vice-chairman; H. M. Church (B. & O.), C. C. Cook (B. & O.), G. M. Davidson (C. & N. W.), A. F. Dorley (M. P.), E. G. Lane (B. & O.), Curtiss Millard (C. G. W.), A. Mordecai (Cons. Engr.), W. A. Parker (S. J. & G. I.), Chas. E. Thomas (I. C.), committee.

The report was received without discussion and the committee relieved.

GRADING OF LUMBER.

One of the aims of the committee was to secure the actual adoption of the rules drawn up jointly by this committee and the various lumber manufacturers' organizations. The committee can report this year that the standard rules for maintenance of way lumber adopted last year by this association, when submitted back to the lumber organizations interested, were agreed to, with slight modifications, as follows:

For southern yellow pine, by the Yellow Pine Manufacturers' Association.

For hardwoods, by the Hardwood Manufacturers' Association of the United States.

For Douglas fir, by the West Coast Lumber Manufacturers' Association.

The Northern Pine Manufacturers' Association refused to accept the white pine rules. The acceptance of the rules adopted last year by the three associations referred to was made subject to slight modifications in the rules made since the time when these rules were first proposed. These modifications are so slight, however, that the committee believes that they can be readily adjusted in individual cases.

The committee has been engaged in making further studies of rules for classes of lumber not included in the rules already adopted. These considerations are well under way, and it is expected two or three additional sets of rules will be ready for submission next year.

Consideration has also been given to the grading rules for cypress submitted for information last year.

The committee recommends that the lumber grading rules for cypress, as published in Appendix E, Bulletin No. 144

Dr. H. Von Schrenk, Chairman; B. A. Wood, Vice-Chairman; W. McC. Bond, D. Fairchild, R. Koehler, A. J. Neafie, W. H. Norris, J. J. Taylor, F. B. Walker, Committee.

The rules submitted last year on cypress were adopted, to be included in the Manual.

DR. H. VON SCHRENK,
Chairman Committee on Grading of Lumber.

W. M. DAWLEY,
Chairman Committee on Roadway.

ROADWAY.

The committee on roadway has had under consideration during the past year the four subjects assigned by the Board of Direction.

PRESENT FORMULAS OF GENERAL APPLICATION FOR DETERMINING WATERWAY AREAS UNDER VARYING CONDITIONS, INCLUDING CONSIDERATION OF HYDRAULIC FEATURES.

Considerable space has been given to the subject of waterway areas in the Association bulletins and proceedings in recent years, and somewhat favorable action has been taken tending to support the general practice of using formulas as an aid to the judgment in such work. Successive reassignments of this subject for committee work has been made by the board during the past two years and some further progress has been made. It does not appear, however, that data can be had at this time which would justify a further attempt to derive a simple formula having general application.

On the subject of the hydraulic features of culverts considerable information has been collected, but owing to incompleteness of certain features, it is deemed advisable to defer the presentation till a later date in one of the Association bulletins.

REPORT ON AND RECOMMEND UNIT PRESSURES ALLOWABLE ON ROADBEDS OF DIFFERENT MATERIALS, CONFERRING WITH COMMITTEE ON BALLAST.

The chairman of the committee on ballast advises that "the determination of the proper unit pressure with any degree of accuracy and without guesswork necessitates certain tests or experiments, and so far the ballast committee has not been able to find any information on this subject which has not already been given to the Association"; and the committee on roadway has failed to discover anything new on the bearing power of soils or on the magnitude of the unit pressures to be carried by the roadbed.

Under these circumstances the committee can do no more than again direct attention to the following resolution heretofore submitted:

"Resolved, That the Board of Direction be requested to set aside an appropriation and to appoint a special committee, consisting of members of the roadway, ballast and track committees, to make experiments to determine the magnitude and distribution of the load transmitted to the roadbed through ballast of various kinds and also to determine by test the bearing power of various materials under varying conditions ordinarily found in the construction of the roadway."

As the experiments should extend over a considerable period of time to cover seasonal variations and should be conducted under actual traffic conditions, the expense would be quite heavy and probably should be borne jointly by several of the larger railroad systems. The present high percentage of rail failures, together with the undoubted advent of the 100-ton car and the constant increase of locomotive axle loads, make it imperative that some systematic study of the roadbed be made as a foundation for the track.

REPORT ON TUNNEL CONSTRUCTION AND VENTILATION. THE VENTILATION OF SUBWAY TUNNELS.

The ways in which subways have been ventilated may conveniently be considered under four separate heads:

(1) By introducing or exhausting air at various points by means of fans.

(2) By forcing a current of air from one end to the other of the whole line by fans.

(3) By so-called natural ventilation.

(4) By the piston action of trains.

Fans are almost invariably employed to exhaust air, not to supply it. They may exhaust through side chambers directly to the outside air, as in older portions of the Boston subway, or by means of air ducts communicating at various points, as in the Severn and Mersey tunnels. In the former case a number of comparatively small ventilating fans are employed at the points where the air is to be extracted; in the latter

large central pumping plants are used. In any case, fresh air is expected to enter at stations or other appropriate points as rapidly as the foul air is exhausted.

In the plenum principle the fresh air is forced in by the fans and the foul air escapes as best it can. This method is more often used to supply air during construction of deep subways than in subways after they are built. Many arguments have been brought forward to show the advantages of renewing the air at stations rather than elsewhere. It has been urged, for example, that the air should be exhausted between stations and allowed to flow in at the stations, since more passengers are congregated at stations than at other points, and in this way they will get the freshest air; the air in the cars is renewed at stations and not between them, so the air should be at its best there, and this method would most rapidly remove smoke and heat in case of fire and give the best opportunity for escape through the stations.

The earliest use of a fan for assisting the ventilation of a railway tunnel is believed to have been in 1870 in connection with the Lime street tunnel of the London & Northwestern Railway at Liverpool. Following the generous proportions of fans which had been employed in ventilating mines, this fan was 29½ ft. in diameter and discharged its air into a conical brick chimney 54 ft. in diameter at the base. The quantity of air thrown was 431,000 cu. ft. per minute. The air was taken from a point midway between the two ends of the tunnel. The tunnel was 6,075 ft. in length.

The Boston subway is about 4 1/3 miles long and is operated by electricity. It is used by trains and single trolley cars, most of whose routes lie in the open air. The speed is so slow that the ventilating currents set up by the moving cars are often scarcely noticeable. The typical section is 332 sq. ft. where the subway is occupied by two tracks and 707 sq. ft. where it is four tracks wide. In the section of the road first built ventilating fans are placed in chambers alongside the subway at points between stations and the air is discharged upwards through grated openings in the sidewalk overhead or through short shafts to the other air. The fans are 7 to 8 ft. in diameter. They were intended to be of such capacity as to enable them to completely renew the air every ten minutes. In the section under the harbor the same general plan is followed of taking air in at the stations and removing it between stations. In this case, however, an exhaust duct has been placed along the top of the tunnel with occasional openings which can be opened or closed at pleasure. The cross-section of the duct is about 48 sq. ft.; the openings are about 4 ft. long and 1 ft. 5 in. wide and they are placed at intervals of about 550 ft. The air is withdrawn at each end of the tunnel and exhausted by means of fans through shafts about one mile apart, on the opposite shores. At the East Boston end the air is exhausted through grated openings in the sidewalk 40 ft. long and 7 ft. 1 in. wide. At the other end the air is discharged about 21 ft. above the surface of the street. The fans consist of two 8-ft. vertical fans at the East Boston end and two 7-ft. horizontal fans at the Atlantic avenue shaft. At 175 to 218 revolutions per minute and about 12 h. p. each, the total rated capacity of the whole ventilating plant is 90,000 cu. ft. per minute. This gives a theoretical velocity for the whole air in the tunnel of about 2½ ft. per second and is equivalent to a renewal of the air every fifteen minutes.

The Severn tunnel of the Great Western Railway was opened in 1886. It is about 4⅝ miles long. It is occupied by two tracks for steam railway travel. There is a ventilating shaft located near the center, through which air is exhausted by means of a fan 40 ft. in diameter. It is said that the capacity of the fan is sufficient to renew the air of the tunnel about every ten minutes.

The Mersey tunnel, connecting the cities of Liverpool and Birkenhead, is about 2 miles long and is occupied by a double line of electric railway. Air is exhausted through numerous passages communicating with ventilating galleries which lead to exhaust fans. These fans are from 12 to 40 ft. in diameter and are located at stations above ground. The combined capacity of these fans is estimated to be about 950,000 cu. ft. per minute, or sufficient to renew the air of the tunnel every nine minutes. This tunnel is often referred to as affording an example of the most perfect system of artificial ventilation yet devised. It was certainly the earliest tunnel in which a comprehensive system was adopted.

The general plan of ventilating the new tubes of the Electric Underground Railways Company of London is to take advantage of the piston action of the trains, as do all the London subways, and to supplement this by fans at the stations. The fans exhaust air from beneath the station platforms and carry it through airways averaging 12 to 16 ft. in cross-section to the roofs of the buildings used for subway stations, there to be discharged into the free atmosphere. The fresh air enters through these stations, stairways and lifts. The fans are of a designed capacity sufficient to remove 1,000,000 cu. ft. of air per hour when working at moderate speed. This is sufficient to renew all the air in the average length of subway between two stations in each of the parallel tunnels every 30 minutes. The fans are located at the tops of the buildings. They have been found, upon test, to deliver 18,250 cu. ft. per minute when operated at a velocity of 242 revolutions per minute. Great care was used to avoid vibration and noise from the motors and fans.

A system of forcing air through an electric subway has been installed in connection with the Central London Underground, a good example of the deep London tubes. The ventilating arrangement of the Central London Railway is capable of renewing all the air contained in this subway three times over every night. In order to accomplish this result double doors are arranged at the station entrances and shut at night. The air flows in at the city end of the Bank of England, passes through the two tubes, each over six miles long, and is exhausted by a fan at Shepherd's Bush.

The fan is 20 ft. in diameter and of the Guibal type. It is said to be capable of exhausting 100,000 cu. ft. of air a minute as measured at a point near the far end of the line. During the day it is not possible to run this far with much effect, because, with opening the station doors by passengers, it draws air from the stations, chiefly from the nearest one. But at night after the last train has run out of the subway on the surface at the west end all the doors are closed and the fan is started. It is kept going until the first train is run in the morning. The results are said to be excellent.

Although many subways are now provided with some system of ventilation requiring the use of fans, by far the greatest number still depend for a circulation of air upon currents set up without special mechanical aid. Among the more common ways of securing the so-called natural ventilation, the use of blowholes, or free openings to the outside air, deserves special notice. It is to ventilation accomplished in this way that the frequent renewal of air in the New York subway is due. The draught of air passing through the blowholes is sometimes violent. An average velocity of 16½ miles per hour through the stairways of the New York subway was observed as a result of several hours' observation with anemometers. Had this current taken place through one-half of the openings between Ninety-sixth street and the Brooklyn Bridge, the quantity of air so supplied would have been capable of renewing the entire atmosphere of the subway every few minutes. At first sight it would appear that nothing could be easier than to ventilate a subway by this means. It seems as simple as opening the window of a living room. Yet to get the best effects from blowholes, ventilation means much more than the opening of the roof. To provide for a suitable and reliable movement of air requires careful study. Apparently the very simplicity of the idea of blowhole ventilation has prevented the development of this principle in the best manner. To some subways and tunnels it is peculiarly suited. The term blowhole is here used to include all openings through which the confined air can escape and fresh air enter, whether they be stairways, openings in the roof or openings through side chambers. In shallow subways such openings usually pierce the roof or lead from station platforms with more or less directness to the outside air. They are usually much too small, too indirect and too long to accomplish all the benefit which may be obtained from them.

Inasmuch as the flow of the air is impeded by friction against the walls, blowholes should be as short as practicable. Since the friction increases as the square of the velocity of the current and inversely as the diameter of the passage, they should be large in section and but little obstructed by screen, doorways, nettings and other incumbrances. It is easy to see that blowholes may be more advantageously employed in subways built near the surface of the ground than in railways far beneath the surface. And yet this is the only way in which some of the deep London tubes are ventilated. If, as sometimes happens, the blowholes are open stairways covered by cowl-like kiosks, the direction of the openings with respect to prevailing breezes may materially aid or interfere with the amount of air which passes in or out. Let us briefly examine this effect.

The action of moving trains is more important than any other factor in establishing a circulation of air through blowholes. This so-called piston or plunger action has long been recognized as useful, but it has remained for the New York subway to demonstrate how extremely beneficial it may be. The main principle of the phenomenon of piston action is easily understood. The moving trains force air ahead of them and cause air to rush in after they are passed. The

quantity of air moved depends upon many circumstances. Chief of these are the extent to which the tunnel section is filled by the section of the train; the speed of the train; the opportunity afforded by blowholes for the air to flow in and out; and the shape of the forward end of the train.

In studies made on the Berlin-Zossen railway into the resistance offered by the free outside atmosphere to the movement of trains, it was found that air piled up in front of the first car in the form of a cone of increased pressure and that a cone of reduced pressure followed behind the train. For example, the pressure in front of a car which presented a face perpendicular to the line of the track was 4.09 lbs. per sq. ft. at a speed of 12.4 miles per hour; 6.14 lbs. at 18.6 miles; 8.19 lbs. at 24.8 miles. This pressure was maintained for between 10 and 16 ft. in front of the moving train; beyond this it gradually fell off.

Observations made in the New York subway before any material changes were made in the arrangements for ventilation, with the ordinary train service of early afternoon, have shown that air passed from one station to another sometimes at a rate of over 8 miles per hour and at an average of about 3 miles. The approach of a train toward a station on the four-track road could be felt by the flow of air ahead of it while the train was over 1,000 ft. away.

The exhaling and inhaling action due to the operation of trains is of peculiar value in that it occurs when and where most needed, provided, of course, that the openings to the outside air are properly placed and unencumbered. The greater the number of passengers carried and the greater the number of trains, the greater is the amount of ventilation. And not the least conspicuous of the advantages of so-called natural ventilation is its economy.

No expense is necessary for the operation of mechanical devices in natural ventilation. Experience with the New York subway shows that it is not always necessary or desirable for a train to fit very closely into the tunnel section. In fact it is conceivable that when this fit is close, the cars carry along more of their own air than desirable and the passengers within them enjoy much less interchange than would take place otherwise.

The details of construction and equipment of the New York subway have been made the subject of so many extended and authoritative accounts that it is unnecessary to deal exhaustively with these questions here. The subway structure may briefly be described as virtually a steel cage enclosed and embedded in concrete. The walls and roof were alike in design, consisting of beams weighing from 42 to 70 lbs. per foot, placed about 5 ft. apart. Between these beams square, steel rods 1¼ in. long were placed to the extent of from 4 to 7 per 5-ft. panel. Round rods ⅝ in. diameter connected the columns about 2 ft. below the under face of the roof. The rods were set back from the inner face of the tunnel 2 in., but the beams projected to the surface.

Between the beams of the roof and sides comparatively thin walls of concrete imbedded the steel cage. This concrete has a thickness at the walls of from 14 to 16 in., exclusive of a thin protective wall of waterproofing outside, and of a space of variable thickness occupied by hollow ducts intended to contain electric cables. The roof has a thickness which varies from 18½ to 21½ in. In the four-track section of the subway rows of steel columns extend between each two lines of track at intervals of 5 ft. to support the roof. The floor is of concrete with an enclosed layer of waterproofing.

Nearly all of the studies recorded here, except those of temperature and humidity, refer especially to the representative section between Ninety-sixth street and Brooklyn Bridge. In many cases they have a much wider application. The length of this section was about 6 miles. The cubic air space included was in round figures 26,100,000 cu. ft., including the stations. The section was four tracks wide, excepting a piece of tunnel which ran between Forty-second and Thirty-fourth streets. Here there were two tunnels of two tracks each, running side by side, cut through the rock. The subway was ventilated through the stairways at the stations and through blowholes in the roof. All of the blowholes which were originally built were located in that portion of the road which lay above Sixtieth street. They were rectangular in shape, and opened upon small grass plots which occupied the center of a wide boulevard known as Upper Broadway. Iron railings surrounded the openings. To prevent the entrance of large objects the openings were covered with coarse wire netting.

The blowholes were located above the center of the railway, one being situated a little beyond each end of each station. An additional blowhole was placed midway between stations. The total number of blowholes between Fifty-ninth and Ninety-sixth streets was 18. Each was about 7x14½ ft. in the clear. Wire nettings, beams and other objects took up about one-quarter or more of their space so that the total effective area from these blowholes was about 1,368 sq. ft. Sections of the vault lights were early removed from the stations at Seventy-second and Ninety-sixth streets and left unobstructed by nettings. The area removed at Seventy-second street was about 108 sq. ft. and at Ninety-sixth street about 478 sq. ft. This greatly relieved the unsatisfactory condition of the air at Seventy-second street, where the subentrances had been covered by a building, and at Ninety-sixth street where the roof was very low and the extent of the vault lights extraordinarily great.

The stairways between the streets and the stations varied somewhat as to width and direction. Below Fifty-ninth street they were usually placed at right angles to the line of the road; above Fifty-ninth street they were parallel to the road. There were usually two stairways, each in cross-section about 5½x7½ ft., to each local station above Fifty-ninth street and eight narrower ones to the other local stations.

The subway was about 59 ft. wide and 18 ft. high on the four-track section between Brooklyn Bridge and Ninety-sixth street and the cross-section of a car occupied about 14 per cent. of this section. The trains were from about 150 ft. to 408 ft. long. The local trains usually consisted of five cars and ran at a rate, exclusive of stops, of about 21 miles per hour. The express trains generally consisted of eight cars and ran at a rate, exclusive of stops, of about 26 miles per hour.

As a train moved through the subway air was forced ahead of it and air followed it. As a rule, a general current flowed along the track on each side of the subway in the direction of the train movement, and these currents continued even when no train was within hearing distance. The important action of a train was to force air along with it, but where stairways or blowholes occurred and offered lines of diminished resistance, the air rushed out through them as a train approached and rushed in as the train went by. The difference in barometric pressure necessary to set up these air currents was exceedingly slight; the effects of friction against the walls and pillars of the subway and the sides of the stairways considerable. A great part of the force with which the air currents were set in motion was generally used up in eddies about the trains.

The movement of the air depended upon the speed of the nearest train, the movement of other trains in the vicinity, the size and location of the neighboring openings to the outside air, the size of the particular cross-section of the subway with reference to the sections of the moving trains, the force and direction of the wind in the streets with reference to the position of the stairways, the difference in temperature inside and outside of the subway and other conditions.

From approximate computations made in a number of ways, it is practically certain that the air was renewed at least as often as once every half hour.

With the object of reducing the heat which had made the air uncomfortably warm during the summer months extensive alterations were made in ventilating arrangements of the New York subway after the above observations were made. The plan embodied several features.

Large sections of the roof were removed at the stations and the openings were covered with gratings. The aggregate area of the opening when allowance was made for the gratings was 2,356 sq. ft. in the section from the Brooklyn Bridge to Columbus Circle, and 1,805 sq. ft. in the section between the latter point and Ninety-sixth street. It was calculated that these openings, together with the openings at the station stairways, etc., would give a ratio of 1 sq. ft. of blowholes for every 3,200 cu. ft. of contents at each station. Blowholes, opening generally from specially constructed chambers, were also provided between stations. These blowholes were fitted with air valves and fans, the object of the arrangement being to induce fresh air to enter at the stations, and pass out through the blowholes between stations.

The air valves, called louvres, were made of galvanized iron and were so fitted into sheet iron boxes that when shut they entirely closed the area of the blowholes in which they were placed. The valves swung automatically upon axles, being so counterweighted as to open and let air out when it was forced ahead by the trains and then close and prevent fresh air from getting in after the trains had passed. The ventilation with the valves was like the natural ventilation which would have taken place without them, in one respect; they were entirely dependent upon the movements of the trains, producing an amount of ventilation which was proportioned to the number of trains passing in a given period.

The fans have been placed at the ventilating openings between stations to accelerate ventilation under special circum-

stances, such, for example, as at night when few trains are running and in order to free the subway of smoke in case of fire. The fans are of the centrifugal type popularly known as blowers. They are from 5 to 7 ft. in diameter. They are operated by electric motors of 15 to 30 horse-power capacity and when run at their normal speed of 235 to 330 revolutions per minute are said to be capable of discharging about 990,000 cu. ft. of air per minute. On the basis that the fans are really capable of operating as effectively as assumed, they should be able to renew the air between Columbus Circle and Brooklyn Bridge in 19 minutes.

A plant for cooling the air at the Brooklyn Bridge station was constructed in 1906. The project required that the heated air of this station should be passed by means of a centrifugal fan over coils of cold water and distributed through ducts opening immediately over the heads of the passengers at the station.

The quantity of air cooled is about 75,000 cu. ft. per minute for each of the two units into which the plant is divided. When first put in operation, it was found that there was a transfer of heat between 9.4 and 11.3 B. T. U. per square foot per degree of difference between the air and the water and that the air which came in contact with the pipes could be cooled about 8 deg. under the conditions of practical operation.

VENTILATION OF THE HUDSON RIVER TUNNELS.

The tunnel system of the Hudson & Manhattan railroad company has been in operation about five years between Hoboken, N. J., and Sixth avenue, New York, and the downtown section between Hoboken and Church street, New York, about four years. Those sections now in operation extend from the Terminal building, at the lower end of New York, under the Hudson River to Jersey City, thence underground to the Erie and Lackawanna railroad stations, whence they pass under the river again back to Manhattan at a point about 1¼ miles above the downtown tubes. Continuing below ground, the tunnels extend to Sixth avenue and thence to Thirty-third street. In Jersey City the line to Newark comes to the surface about 1½ miles west of the Pennsylvania Railroad Station. Extensions now under way will carry the tunnels further up Sixth avenue and eventually to the Grand Central Station at Forty-second street and Fourth avenue.

The total length of the tunnels when completed will be 19 miles.

The Hudson tunnels were designed by Charles M. Jacobs, the chief engineer of the Hudson Companies. They are single track tubes, there being no connection between adjacent tubes except at junctions and at some stations. This plan has been adopted throughout, and it is of great importance in the ventilation, as only by this means can full advantages be taken of the piston action of the trains to maintain efficient circulation of the air. The Fourteenth, Nineteenth and Twenty-third street stations are constructed on the same principle, but structural and operating requirements would not permit the scheme at other stations.

The effective area of the iron-lined tunnel is 160 sq. ft. and of the concrete-lined tunnel 166 sq. ft. This is with ballast and bench wall in place. The cross-section of the standard tunnel car is approximately 90 sq. ft., which leaves a clearance area of 70 sq. ft. and 76 sq. ft., respectively, for the iron and concrete tunnels.

The original layout of the ventilating system was designed to take full advantage of the piston action of the trains and to draw out the foul air with exhaust fans, while using entrances to admit fresh air. But in three cases it was considered necessary to install fresh air blowers to supplement the air delivered through the entrances, which were either too small or too far apart for this purpose, and also to create sufficient circulation should trains become stalled in the tunnels.

The capacity of the fans was designed to give 30 cu. ft. of air per passenger per minute when traffic is at the maximum during morning and evening rush hours, and this capacity would change the air in the tunnels approximately 2½ times every hour. All fans are motor driven, the motors being coupled direct to the fan shaft. The motors are specially built of the inter-pole type, designed to operate under large voltage fluctuations. They are extremely rugged, reliability being of extreme importance in the installation. The speed variations in these motors is 20 per cent. All speed changes are obtained economically by field control. The motors are designed to operate on a 625-volt circuit which has fluctuations between 500 and 750 volts.

In November, 1909, A. W. Hodgson, assistant engineer of the Hudson & Manhattan railroad, made a series of anemometer tests to ascertain the direction and volume of air circulating through the tunnels and station passageways under existing circumstances. All readings were taken with trains running on 2½ minutes headway, except in the tunnels between caissons 1, 2 and 3, where the headway was 5 minutes. The temperature on the street was close to the freezing point or below. The average velocity of the air from the downtown river tunnels was 1,100 ft. per minute with trains on 2½ minutes headway. The highest recorded temperature in the tunnels was 76½ degrees in August, 1909, when the temperature on the street was 88 deg. Many other parts of the tunnel were only 70 deg. on this date. The average temperature of the tunnel is generally 70 deg. The train headway during rush hours is 1½ minutes with four and five car trains. With trains on 2¼-minute headway, the velocity and direction of the air is governed almost entirely by train movements and not by fans. The large exhaust fans at Church Street Terminal, handling 114,000 cu. ft. of air per minute, increase the velocity in the river section of the south or inbound tunnel less than 10 per cent over the velocity in the north or outbound tunnel. The velocity in the river section of the outbound tunnel was influenced largely by the number of doors and ventilators open at Church Street Terminal entrances, being 180,000 cu. ft. on December 13, and falling to 126,000 cu. ft. per minute on December 23, when all doors and ventilation were closed.

It is, therefore, evident that the function of the fans is only to take the air pushed to them by the trains or to deliver fresh air where the trains can push or draw it in through the stations and tunnels, and this fact should mainly govern the location of fans and air ducts.

In the river sections of the iron-lined tunnels, with trains on 2½-minute headway and attaining an average speed of 30 miles per hour, the mean volume of air passing at any point is 180,000 cu. ft. per minute, provided that the air is not restricted by closing all possible inlets. At island platforms, such as Christopher and Erie stations, also crossovers, such as Ninth street and Nineteenth street, about 70 per cent. of the air crosses the platforms or tracks within 50 feet from the end at which it enters and follows the direction of traffic in the adjacent tunnel. The 30 per cent. leaves the station in the same tunnel in which it enters.

The results prove that wherever passages or connections of considerable area are made between two adjacent tunnels, the section of tunnel between any two such connections must be considered independently, and cannot be efficiently ventilated by fans or shafts not within that section.

In the original design it was considered necessary to install all fans in duplicate. This idea has now been abandoned, as it has been found quite possible to shut down any fan for a day or more for repairs without appreciably affecting the air in the tunnels.

In installations of large capacity, such as are required for a system of deep tunnels, where access to the surface is only possible at long intervals, the design of the fans and air ducts requires very careful study. If they are not properly proportioned, the ventilation will become a very expensive proposition, both in first cost and in operation.

The committee presents the foregoing as information, withholding conclusion until experiments now being conducted on single and double track steam railroad tunnel ventilation are completed.

ECONOMICS IN ROADWAY LABOR.

The committee having agreed with the Track, Signals and Interlocking committees on a subdivision of the work, reports progress.

RECOMMENDATIONS FOR 1913.

The committee recommends that subjects 2, 3 and 4 be reassigned, again respectfully calling attention to the resolution above referred to.

W. M. Dawley (Erie), Chairman; J. A. Spielmann (B. & O.), Vice-Chairman; J. R. W. Ambrose (G. T.), John C. Beye (C. R. I. & P.), Ward Crosby (C. C. & O.), W. C. Curd (M. P.), Paul Didier (B. & O.), R. C. Falconer (Erie), S. B. Fisher (M. K. & T.), Frank Merritt (G. C. & S. F.), C. S. Millard (C. C. C. & St. L), W. D. Pence (Univ. of Wis.), A. C. Prime (P. R. R.), H. J. Slifer (Cons. Engr.), John G. Sullivan (C. P. R.), F. L. Wheaton (D. L. & W.), J. E. Willoughby (Carribeau Cons. Co.), W. P. Wiltsee (N. & W.), Committee.

The report was received as information and the committee was relieved.

RECORDS AND ACCOUNTS.

The board of direction assigned the following work to this committee for the current year:

(1) Make a comprehensive study of the forms in the manual, which were adopted a number of years ago, and bring them up to date.

(2) Continue the study of the economical management of store supplies.

(3) Recommend feasible and useful subdivisions of Interstate Commerce Commission Classification, Account No. 6, with a view to securing uniformity of labor costs.

SUBJECT NO. 1.

Some of the forms, particularly those used in connection with the accounts, such as foremen's reports of labor and material consumed, might be changed in some particulars, but it is doubtful if such changes would bring about their more general use by the railroads, as little, if anything, would be gained by suggesting minor changes in these forms. It is the opinion of the committee that no changes be made at the present time in the forms appearing in the manual. It is suggested that since the selection of the proper forms for time books, foremen's material reports, distribution sheets and authorizations of expenditures is a matter in which the Accounting department is as much interested as the Maintenance of Way department, for the reason that these forms and reports are the foundation of the entire maintenance of way accounting structure, it would be advisable for this association to join with the American Railway Accounting Officers' Association in the development of a set of forms, to be recommended by each association, which would be generally adopted by railways.

SUBJECT NO. 2.

The committee carefully discussed the report made last year with Mr. McVeigh, a representative of the Storekeepers'

H. J. PFEIFER,
Chairman Committee on Records and Accounts.

Association, and we believe that the conclusions which we have reached will meet with the approval of Mr. McVeigh, and that there is a strong probability that they will be approved by the Storekeepers' Association. Discussions were confined to the conclusions approved by the association at the annual meeting in 1912, which were under the following headings:

Standardization.
Classification of Material.
Stock Account.
Distribution.
Organization.

Standardization.—No change is recommended for this heading.

Classification of Material.—The committee recommends that the details of classifications should conform to those adopted by the Railway Storekeepers' Association.

Stock Account.—The conclusion reached last year is fundamental. The detailed methods of keeping the accounts may be varied to fit the individual condition. Stock accounts can be kept, first, by ledger account; second, by card system, and third, by personal inspection and estimation.

Distribution.—No change is recommended for this heading.

Organization.—The essential elements are as follows:

Location.—The store should be located as closely as possible to the point of greatest consumption so that the minimum force will be required, and that the delay to material between the store and its destination may be reduced to a minimum. Usually this is at a point where equipment is maintained.

Force.—The force required is dependent almost entirely on the character and volume of material issued and on local conditions. As the prompt and efficient handling of material and tools has a vital effect on the economical operation and maintenance of the railway, the force in the storeroom should be large enough to bring about this result.

Position in Organization.—The consumption of supplies being greatest in the maintenance of way and equipment, the storekeeper should be closely associated with the heads of these departments. It is the opinion of the committee that this can best be accomplished by having the storekeeper, engineer maintenance of way and the master mechanic report to the same officer. In a divisional organization this would place the division storekeeper under the superintendent and the general storekeeper under the general manager or vice-president in charge of operation.

Mechanical Equipment.—Cost of unloading, storing and loading material depends solely upon the volume of business done by each store, and such appliances as will reduce this cost to a minimum are recommended.

Plan.—A typical layout of a store is presented, which can be expanded or reduced as the situation demands.

SUBJECT NO. 3.

The Interstate Commerce Commission, in their Classification of Operating Expenses, which became effective July 1, 1907, included in the maintenance of way accounts primary Account No. 6—Roadway and Track. This account includes about one-third of the total charges for material and labor in the maintenance of way and structures accounts. This account includes practically all of the labor performed by section and extra gangs chargeable to the maintenance of way and structures operating expenses, and it seems desirable to provide subdivisions of this primary account in order to analyze operating expenses and assist in securing uniformity of labor costs.

A brief outline of the reasons for recommending the proposed sub-accounts is as follows:

Sub-Account A—Track Maintenance:

Under this caption is included all labor necessary to maintain good line and surface of track, except for the application of material. In other words, if the material and drainage conditions are good, but the track is in poor line and surface, the labor necessary to place the track in good condition will be charged to this sub-account. Also, if it is necessary to temporarily reduce expenses, the available force should be used on line and surface work so far as possible.

Sub-Account B—Applying Track Materials:

Applying track materials is subdivided into
(B-1) Applying Ballast;
(B-2) Applying Ties;
(B-3) Applying Rails;
(B-4) Applying Other Track Material.

These sub-accounts will furnish as much detail as is practicable for convenience in comparing labor costs.

Sub-Account C—Cutting Weeds and General Cleaning:

This sub-account includes work which is less important than some of the other items, and the amount expended is largely dependent upon keeping the property in presentable condition rather than for reasons affecting safety or economy.

Sub-Account D—Ditching and Bank Widening:

This sub-account includes the most important element in providing good track. Frequently the material removed from cuts is used in widening embankments and, therefore, ditching and bank widening are logically included in the same sub-account.

Sub-Account E—Changing Alignment and Grades:

Under this caption is included the operating expenses resulting from abandoning the present alignment on account of reduction of grades or curvature, and it is necessary to separate this from the other expenses which more directly affect the economical maintenance of the property.

Sub-Account F—Flood Damage:

This sub-account includes the cost of repairing damage to the roadbed and track caused by unusual conditions, such as cloudbursts, floods, etc. It is necessary to separate this class of expenditures from the ordinary maintenance work in order that the latter may truly reflect the average expenses in maintaining the property. This sub-account also furnishes the basis for investigations to determine the amount which may be profitably expended to eliminate future damage.

Sub-Account G—Bank Protection:

Under this caption is included expenses necessary to protect the roadbed and track from slides, washouts and other unusual damage to the property.

Sub-Account H—Filling:

This sub-account provides for the expense of filling bridges.

Sub-Account I—Other Care of Roadway and Track:

This sub-account is intended to include the cost of track-walkers, watchmen and other expenses not specifically provided for in the other sub-accounts.

It is the opinion of the committee that the subdivisions of the Interstate Commerce Commission Classification, Account No. 6, of Operating Expenses, will be of assistance in securing uniformity of labor costs, but in order to obtain the greatest efficiency and most economical results additional information must be obtained and action taken.

Some of the most important elements in securing uniformity of labor costs and efficiency in handling work are as follows:

(1) Adoption of proper method for doing the various kinds of work under usual conditions. Efficiency in the various kinds of work performed in the Maintenance of Way department has received very little study up to the present time, and it is safe to say that practically the same methods are being followed to-day that have been in use for a great many years. As an illustration, there are probably as many methods employed by section foremen in putting in ties under the same conditions as there are foremen doing this work, and by making a careful study of the elements entering into each operation the best method employed by each foreman may be combined to produce an approved practice for the various items of work under the most usual conditions.

(2) Economical distribution of material so as to reduce the amount of labor necessary in applying.

(3) The selection of proper tools and their maintenance in good condition.

(4) Organization and supervision.

(5) The selection of the proper season of the year for performing the various kinds of work.

H. J. Pfeifer, chairman; M. C. Byers, vice-chairman; J. M. Brown, Edward Gray, E. E. Hanna, Henry Lehn, J. H. Milburn, C. W. Pifer, Guy Scott, W. A. Christian, G. J. Graves, Orlando K. Morgan, Walt. Dennis, G. D. Hill, Frank Ringer, Committee.

The report was received as information.

OTHER BUSINESS.

Mr. Kittredge: I desire to offer the following resolution:

Resolved, by the members of the American Railway Engineering Association in convention assembled, That we desire to, and hereby do, give an expression of appreciation of the able manner in which the retiring president, Charles S. Churchill, has discharged the duties of president during the past year and presided over the meetings of this convention; that this resolution be spread upon the minutes and a copy be furnished to Mr. Churchill.

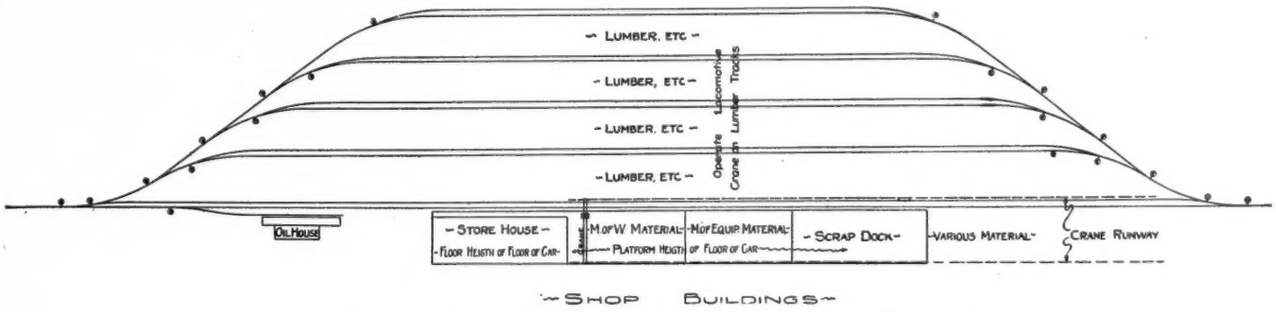
L. C. Fritch: I move that this resolution be adopted, that it be made unanimous, and that the vote be a rising vote.

(The motion seconded and the resolution was unanimously adopted amid applause.)

The President: I thank you very much, gentlemen, for your kind expressions. As one of the ancient members of this association, I enjoy appreciation of this kind. I consider it an honor to have had this position. I wish success to my successor. I know he will have it, because in this association every officer has the hearty support of all the members. That is one peculiarity of this association above all others with which I am acquainted. This is a working organization; it has the respect and esteem of the whole of the United States. It is growing in power and in the results accomplished by it daily, and it is all by the co-operation, by the frank discussion, by turning down mistakes that are made that are clearly mistakes, and by making corrections promptly—in that way we will keep up with the times, and that is what we are trying to do as railroad people. We have got to be alive, up-to-date, and take up the new questions that have been suggested and follow them out to the limit. I thank you, gentlemen.

Address of President-Elect Edwin F. Wendt.

I deeply appreciate the honor which you have conferred upon me. It will be my purpose to so work as to merit your confidence. With your help the work of this association during the coming year will be carried to a successful conclusion. This success will depend on the co-operation of many elements. During next year we expect to have Secretary E. H. Fritch with us, as in the past, however at an increased salary. The Entertainment Committee has been so successful as to have earned what will probably be a life tenure of office. Furthermore, as a business organization we feel justified in congratulating ourselves on having with us year after year two such skillful and faithful stenographers as have served us for so many years. Then, again, I feel that we are justified in saying even another word respecting the value of the exhibition which is given by the National Railway Appliances Association. I had the pleasure yesterday of going through that exhibition and ascertained that the direct expense of that exhibition amounts to as much as $27,000 per year. The attendance at the exhibition is fully up to 50,000 people, and many of whom are employes of railroads for a distance of 1,000 miles from Chicago. That exhibition also represents a capital of not less than $495,000,000.



Typical Layout for Maintenance Department Stores.

Furthermore, we are especially fortunate in having as an aid to the work of our association the technical press, and however excellent their publications have been in the past with respect to our association, we confidently expect that their work will be carried on year by year, even to the greater benefit of our membership. The committees of this association are responsible for the direct, tangible results which find their expression finally in the Manual. Without the help of these 20 standing committees we would accomplish very little, and I say that the thorough work which is done in committee is that which receives the greatest approbation of the membership in general.

If we accomplish in the future that which we wish to accomplish, it is essential that we get more members. At the first of January our membership was 1066. Today we are pleased to say that the membership is about 1115. There are, however, in this country, at least 1500, and no doubt 2,000 persons who ought to be members of our association. They ought to be members because they can do this association much good and because they can derive from the association an equal benefit.

The object of our association is the advancement of the scientific study of those problems that pertain to the construction and maintenance of railways. We believe that the results of this scientific study will be of very great benefit to ourselves and to the railways of America. If we pursue the object of this association and bring about the scientific study of those problems which confront us and temper theory with experience we will have accomplished that which was the intention of the framers of the constitution. Our association was born in the tranquil days which characterized the opening of the 20th century, but since that time there has been a development on the part of the public, so that in 1906 Congress passed the Hepburn Act, which has brought about a great deal of discussion and much disturbance of financial conditions in connection with our business. We must meet these new conditions which have arisen since 1906 under the policy of government regulation, and I for one have no doubt that when we direct our intelligence to the determination of

the scientific principles which underlie the success of the railway business we will be satisfied that a conservative policy of regulation will meet our approval.

A great work before the country during the next few years will be that of the valuation of railways. The Board of Direction has discussed this question for several years and has now under consideration the question as to what action, or what attitude our association should take with reference to this great problem. It is a tremendous problem, one which is being undertaken, we fear, without proper preliminary study, and it behooves every member of our organization to intelligently direct his energies toward the proper solution of this great question. We have in our midst those persons who are able to do this work and we should emphasize the point that was raised by several of the speakers last evening, that our membership should speak freely its mind with respect to the underlying principles which should govern the determination of this great question and I for one will venture a prediction that when the railways of America are intelligently valued the public will discover, contrary to its present idea, that the railway companies and properties are worth a great deal more in money than their present capital.

If there is no other business to come before this convention the Fourteenth Annual Convention will now stand adjourned.

REGISTRATION—AMERICAN RAILWAY ENGINEERING ASSOCIATION.

MEMBERS.

Archer, Wm., Asst. Eng., B. & O. S. W., Cincinnati.
Backes, W. J., Eng. M. W., N. Y. N. H. & H. R. R., New Haven, Conn.
Bell, Gilbert J., Div. Eng., A. T. & S. F. Ry., Marceline, Mo.
Blackman, Chas. H., Asst. Eng., L. & N. R. R., Louisville, Ky.
Boynton, C. W., Ch. Insp. Eng., Universal Portland Cement Co., Chicago.
Chamberlain, O. P., Chief Engineer, C. & I. W. R. R., Chicago.
Cochran, C. W., Eng. M. W., Big Four, Mt. Carmel, Ill.
Crittenden, O. H., Ch. Eng., I. & G. N. R. R., Houston, Texas.
Cunningham, A. O., Chief Engineer, Wabash R. R., St. Louis, Mo.
Curtis, L. G., Dist. Eng., B. & O. C. Ter. R. R., Chicago, Ill.
Dick, H. B., Eng. M. W., B. & O. S. W. R. R., Cincinnati, Ohio.
Eberly, G. F., Asst. Div. Eng., B. & O. R. R., Newark, Ohio.
Garman, H. O., Instructor C. E., Purdue Univ., Lafayette, Ind.
Gibson, H. R., Div. Eng., B. & O. S. W. R. R., Flora, Ill.
Gilbert, H. H., Eng. B. & B., Queen & Crescent Route, Cincinnati, Ohio.
Houghton, E. R., Asst. Eng., U. P. R. R., Omaha, Neb.
Hoyt, C. B., Supt. Tr., N. Y. C. & St. L. R. R., Bellevue, O.
Hynes, M. V., Supt., C. H. & D. Ry., Cincinnati, Ohio.
Johnston, T. S., Ch. Eng., C. A. & N. Ry., Chicago, Ill.
King, E. E., Iowa State College, Ames, Iowa.
Lane, H. A., Asst. Eng. Surveys, B. & O. R. R., Baltimore, Md.
Lehn, Henry, M. W. Acct., N. Y. C., New York.
Parrish, F. J., First Asst. to E. M. W., B. & O. S. W., Cincinnati, Ohio.
Smith, F. A., Civil Engineer, Chicago, Ill.
Smith, W. A., Res. Eng., Erie Railroad, New York.
Smith, W. W., Asst. Eng., G. T. Ry., Montreal, Canada.
Stelle, C. A., Div. Eng., C. & A. Ry., Bloomington, Ill.
Stocker, J. A., Ch. Eng., Toledo & Ohio Cen. Ry., Columbus, O.
Thomas, Chas. E., Contr. Eng., Mt. Pulaski, Ill.
Ziegweid, A. B., Div. Eng., M. C. R. R., Saginaw, Mich.

GUESTS.

Abbott, George W., Act. Div. Eng., B. & A., Boston, Mass.
Bellamy, B. C., Union Pacific, Laramie, Wyo.
Brannon, C., Asst. Eng., C. & E. I., Evansville, Ind.
Deuer, H. W., Trainmaster, C. M. & St. P., Ottumwa Junction,
Espenshade, E. B., Asst. Eng., Pere Marquette, Chicago.
Gardner, C. L., Supt., T. & O. C., Columbus, O.
Lloyd, J. E., Asst. Div. Eng., B. O., Ganett, Ind.
Moore, W. G., Asst. Eng., Operating Dept., B. & O., Baltimore.
Robinson, W. M., Jr., Special Engineer, Georgia R. R., Augusta, Ga.
Rockwell, W. F., Ill. Steel Co., Gary, Ind.
Schnyer, H. F., Asst. Eng., T. & O. C., Columbus, O.
Shea, Wm., Roadmaster, C. M. & St. P., Ottumwa, Ia.
Wenzell, A. J., Ch. Eng., Michigan Railway Engineering Co., Kalamazoo, Mich.

SPECIAL CAR FOR BOSTON.

The Lake Shore & Michigan Southern, for the convenience of persons attending the convention, will operate a special car for Boston on its train leaving Chicago at 10:30 this morning.

MEETING OF TELEGRAPH SUPERINTENDENTS ASSOCIATION.

The Association of Railway Telegraph Superintendents held a quarterly meeting in the assembly room at the North Western office building, Wednesday, March 19. After the meeting a joint meeting of the committees on arrangements of this Association and of the Telephone and Telegraph Appliance Association was held to make preliminary arrangements for the annual convention to be held in St. Louis during the week commencing Monday, May 19. There will be no organized exhibit in connection with this meeting.

J. J. Ghegan, J. H. Bunnell & Co., New York, is chairman of the Telephone and Telegraph Appliances Association; E. E. Hudson, Thomas A. Edison Company, Inc., is vice-chairman, and W. E. Harkness, United States Electric Company is secretary and treasurer. E. A. Chenery, superintendent of telegraph of the Missouri Pacific, is chairman of the arrangements committee of the Telegraph Superintendents Association.

CLASSIFICATION OF MEMBERS OF THE A. R. E. A.

Presidents	25
Assistants to Presidents	8
Vice-Presidents	29
General Managers	17
Director of Maintenance and Operation	1
Assistant General Managers	10
General Superintendents	15
Assistant General Superintendents	2
Division Superintendents	42
Chief Engineers	127
Assistant Chief Engineers	24
Principal Assistant Engineers	17
Chief Engineers, Maintenance of Way	5
Assistant Chief Engineers, Maintenance of Way	2
Engineers of Construction	19
Engineers, Maintenance of Way	79
Bridge Engineers	36
Engineer Survey	1
Division Engineers	81
Assistant Engineers	110
District Engineers	15
Electrical Engineers	4
Inspecting Engineers	17
Architects	5
Locating Engineers	5
Engineers, Track and Roadway	10
Maintenance of Way Acct.	1
Engineers, Bridges and Buildings	4
Office Engineers	10
Chief Draftsmen	4
General Roadmaster	1
Roadmasters	16
Master Carpenters	2
Rail Expert	1
Superintendents, Bridges and Buildings	9
Supervisors	3
Resident Engineers	31
Signal Engineers	16
Assistant Signal Engineer	1
Managers, Timber Department	8
Chief Timber Inspector	1
Forester	1
Contracting Engineers	19
Supervisor, Materials	1
Chemists and Engineers of Tests	8
Metallurgical Engineers	2
Professors in Colleges	25

Associate Professors	18
Civil Engineers	37
Consulting Engineers	95
Engineers, Grade Elimination	4
Purchasing Agent	1
Receiver	1
Editors	4
Masonry Engineer	1
Drainage Engineer	1
Valuation Engineers	4
Engineer, Water Service	1
Municipal Engineers	8
Commercial Engineer	1
Miscellaneous	20
Total	1,066

THE THANKS OF THE ASSOCIATION.

The following resolutions were adopted yesterday by the American Railway Engineering Association on motion of L. C. Fritch; seconded by G. W. Kittredge:

"Resolved, by the members of the American Railway Engineering Association, that we desire to place on record our appreciation and extend our hearty thanks to the following: To Mr. B. A. Worthington, Rev. R. W. Dickie, Mr. Geo. A. Post and Mr. R. G. Rennick for their admirable and instructive addresses at our annual dinner; to the National Railway Appliances Association for courtesies extended to the members of the Association, and for the valuable and interesting exhibit of railway devices used in the construction, operation and maintenance of railways; to the technical press for their daily reports of the convention and useful information made available to the members; to the official reporters, Messrs. T. E. Crossman and G. W. Burgoyne for their accurate and painstaking reports and the proceedings of this and previous conventions; to the tellers for their arduous labors in counting and tabulating the ballots for officers for the current year; to committee No. 23 on arrangements, for the highly successful arrangements made for the comfort and entertainment of the members and guests attending the convention. And it is recommended to the Board to increase the committee's salary for the coming year."

THE NATIONAL MENACE OF RAILWAY STRIKES.

The directors of the Railway Business Association, who met here on Wednesday, as announced in yesterday's Daily, have given out the following interesting statement:

The country's bare escape during recent months from railway strikes tying up traffic throughout territory containing in some instances nearly half the whole population makes it imperative to remove at once the possibility of such a situation in future.

What will occur if any one of the classes of labor in the operation of railway trains over such an area shall quit work is beyond anything in American experience. It would paralyze society and bring hunger, misery and even death to rich and poor, but especially to the poor.

There is no reason to doubt that demands for increase of wages or more favorable working conditions will frequently take the form of concerted action by employees on many lines at once. The allegation as to cost of living upon which railway employees have relied for public sympathy in their demand for enlarged compensation has been made simultaneously all over the country. The consequent concurrent demand which has developed the large-scale disputes gives every appearance of having become a permanent feature in such negotiations. The Eastern conductors and trainmen have announced a purpose to press demands after the firemen's case is concluded.

The urgency of the situation leads the Railway Business Association to go outside its main function of conciliation between railways and the public and seek to arouse the public, the railway employees and the railway managers to co-operation and the President and Congress to action at the extra session. The federal Erdman act, through which until recently strikes causing interruption to train service have been almost wholly prevented, has all but broken down at the point where, mediation failing, arbitration was attempted in the large-scale dispute involving many roads at once. The Eastern engineers' case was arbitrated outside the act. In the Eastern firemen's case the roads agreed to arbitration under the act only after earnest protest and because they believed this to be the only means of averting a strike. The firemen through their officials went on record as favoring amendments which would render the act more applicable to present conditions.

The Erdman act should be amended forthwith or legislation substituted for it providing a form of voluntary arbitration so little open to valid objection as to deprive disputants of all reasonable excuse for declining arbitration under the law. To postpone remedial legislation is to invite widespread and perhaps national disaster at any moment.

While effective in averting strikes through mediation in controversies of whatever extent, the Erdman act is unsatisfactory in large-scale disputes if they reach the arbitration stage.

Arbitration outside the act, on the other hand, as tried in the engineers' case, was declined by the firemen on the ground that they desired the decision to be an award, without recommendation of new legislation, and believed the act would so restrict the findings; and also on the ground that the testimony should be taken under oath as provided by the act.

What are the defects of the Erdman act?

The act provides for a board of but three arbitrators, two of whom represent the respective parties. All concerned urge that a decision involving many roads over a wide area, many thousands of employees and many million dollars annually, should be rendered by a board having more neutrals than one. Provision should be made in the act for fixing upon a larger number when desired. An increase in the proportion of the number of neutral arbitrators to partisans will bring more minds to bear upon the many questions arising in large areas and tend to promote equity in the decisions.

The act limits the time for the investigation to 30 days. It is said that in so short a time the investigation is likely to result in little more than a splitting of differences. The time for the investigation should be made elastic.

If statistics and other data now available are unfitted for this purpose, machinery should be established for standardizing, collecting, keeping and furnishing information which will meet the need.

The statute now affects only employees engaged in train service—engineers, firemen, conductors, trainmen, yard and switch men and telegraphers. Other classes frequently appeal to the government mediators, and their organizations have asked that the law be extended to include them. Some of the most serious strikes affecting large territories have been those of shopmen, signalmen and others not engaged in train service. The act should be made applicable to clerks, trackmen, freight handlers, machinists, boiler-makers, blacksmiths, car repairers and so forth, as well as to the train service groups.

It is urged that the burden of mediation, already heavy, will increase as time goes on, especially if the act is extended to include classes of railway employees other than those in train service. It is also pointed out that only a few federal officers are ex-officio eligible to appointment as mediators. The mediator has the function, when the repre-

sentatives of the parties fail to agree, of appointing neutral arbitrators. There would always be the temptation, in one quarter or another, when a vacancy arose in a position the occupant of which is eligible as mediator, to urge candidates primarily because of their supposed predisposition in labor disputes. Nor is there any assurance that future incumbents, however competent in the offices designated in the statute, will by temperament and training be efficient for the extremely difficult work of mediation. The machinery of mediation should be made adequate to the enlarging demands upon it and eligibility to appointment as a mediator having the function of appointing neutral arbitrators should be made to depend as completely as possible upon personality and experience for the specific function of mediation.

Railway managers, railway employees and the public should co-operate to obtain legislation which will place them squarely on the side of industrial peace and the public convenience and accomplish some progress in the direction of equity for all concerned in the settlement of wage disputes.

Avoidance of the possible horrors of strikes is so imperative that it would seem that the President and the leaders in Congress might well include in their legislative programme for the forthcoming extra session consideration of appropriate measures for the strengthening and improvement of the machinery for arbitration in railway labor controversies.

ASSOCIATION OF PENNSYLVANIA LINES DIVISION ENGINEERS.

The Association of Division Engineers on the Pennsylvania lines west held its spring meeting this week in the assembly hall of the Permanent Manufacturers' Exhibit of Railway Appliances, in the Karpen building, Chicago. The association includes about 40 members and delegates, of which at least 35 were present. All division engineers on the western lines are members of the association, and the officers are elected from among these members. An advisory committee, consisting of the officers and chairmen of committees, selects a number of delegates to the meetings of the association, including a man from the office of the purchasing agent, the assistant engineers of motive power and any other officers that the general manager may suggest. These appointments are approved by the general manager.

This association was organized in 1886, and at present holds two meetings each year; the spring meeting in Chicago during the convention of the American Railway Engineering Association, and the fall meeting in Pittsburgh. George Le Boutillier is president of the association and presided at the meetings. There are seven committees, covering practically all work handled under the direction of division engineers. The most important of these committees are those on Track and Tools, Roadway and Ballast, Bridges and Buildings, Wages and Accounts, and Maintenance. All of the committees presented reports at this meeting.

ELBERT HUBBARD ON "GIVING THE RAILWAYS A SHOW."

"Fra Elbertus,' the sage of East Aurora, and the man who made Emerson famous, visited the Coliseum yesterday afternoon. He had just come from Madison, Wis., where day before yesterday, he delivered before the legislature of that state a lecture on "Giving the Railways a Show." When he got through someone tipped him off to the fact that they already had one this week in Chicago, and he came right down to see about it.

His entrance into the Coliseum was unannounced, and for about thirty feet after he passed the door he was unrecognized. But after his "incog" had been penetrated he submitted to an interview. He said that while this show wasn't the kind he meant to talk about before the solons at Madison, still it was pretty good in its way and was in a class by itself, inasmuch as it was about the only show that railways had been given for some time.

He said he believed, in fact, that if the people of the various states through their representatives in legislature and on commissions would give the railway as good a show in its way as the National Railway Appliances Association is giving them in its own peculiar manner, the railways in turn would be able to show the public, tinged as it is with the "Missouri" spirit, that railway conditions are not so bad after all.

The Fra said he felt quite at home in the various exhibits which he visited. He thought he knew as much about railways as the average citizen. At any rate he has ridden on trains several times in his life. He seemed particularly interested in the signaling exhibits and listened attentively while the various aspects of the subject were explained to him. And from all the indications he understood it perfectly.

He authorized the statement that he believes in advertising.

BRIDGE AND BUILDING ASSOCIATION.

About twenty officers and committee chairmen of the American Railway Bridge and Building Association met at the Congress Hotel late Wednesday afternoon to discuss matters of interest to the association and make preliminary arrangements for the convention at Montreal next fall.

TO-DAY'S PROGRAMME.

The American Railway Engineering Association has this year provided, for the first time, for a fourth day. The day will be spent by the members in visiting the Exhibition of the National Railway Appliances Association in the Coliseum and Armory.

PENNSYLVANIA PUBLIC UTILITIES BILL.

At the public hearing at Harrisburg before the legislative committee having in charge the public utilities bill now pending in the Pennsylvania legislature, George Stuart Patterson, general solicitor of the Pennsylvania Railroad, appeared on behalf of the steam railroads. The following is an abstract of his argument:

The position of the railroads is that:

1. The bill should endow the commission with power to secure reasonable rates and facilities. Nothing in the law, however, should contravene the well-known statement of the United States Supreme Court that "the public is in no sense a general manager."

The function of management should be left to the railroads themselves. To illustrate: The commission should have power to insist that equipment be safe and to pass, if necessary, upon the adequacy of the provision made for safety. It should not, however, be empowered to specify the means by which such safety should be secured.

2. The bill should be clear in its meaning, and its language should in general be the same as that of other similar measures which have already received judicial inter-

pretation. In such manner will the railroads understand the precise purport of their obligations.

3. Above all, the bill must be fair to invested capital. It is comparatively easy to force prosperous companies to submit to any burdens which may be imposed up to the point of actual confiscation.

No way has yet been devised, however, by which a man, or set of men, can be forced to embark upon a new enterprise involving the investment of their money unless there is a reasonable probability of profit from the transaction. Capital is volatile. Create unfavorable atmospheric conditions and it vanishes. It knows no national boundary lines. It seeks unceasingly to find a habitat where it will be welcomed and encouraged.

Now, through the development of its resources by private capital, the commonwealth of Pennsylvania has become the premier industrial state in the Union. Railroads and manufacturers have here prospered. But it is perfectly obvious that if we impose undue burdens, if we restrict the prerogatives of management, if we penalize efficiency, and make it evident that this state will not allow those who risk their capital here to enjoy the fruits of initiative, enterprise and industry—no new railroads will be built, and those which exist will make no improvements involving the slightest risk.

In other words, an impasse will develop through the refusal of private capital further to engage in developing our resources, and the public itself through the government will be forced to embark upon the perilous course of building and managing public utilities.

If government ownership is our goal, we must consider carefully the experience the world has had with government management. In general, it may be said that no country has as yet undertaken government railway ownership as a policy deliberately chosen upon economic grounds. Special and local considerations have determined the choice in practically every case.

The most recent instance of this character is that of the Western Railway in France, acquired by the nation in 1909. In 1909 that company's deficit was $7,750,000; in 1910, $11,700,000; in 1911, $14,000,000; in 1912, $16,000,000; and for 1913, the budget estimates that the people must be taxed $18,000,000 to provide the deficit in railway operation.

NEW ROCKFORD MOTOR CAR.

The Chicago Pneumatic Tool Co., Chicago, has developed a motor car which can be started with a crank and is equipped with clutches, enabling the operator to stop the car without having to stop the motor and to start it without having to push the car and the load.

The car frame is built of 3-in. channels, which is the usual standard for the Rockford cars. All joints are oxy-acetylene welded, and the frame is mounted on 1½-in., semi-elliptical springs to eliminate excessive vibration. The wheels are pressed steel, 16 in. in diameter, with standard M. C. B. tread and flange. One of the wheels on the front axle is given a running fit to compensate on curves and to facilitate the handling of the car when taking it from the track or turning it around on a crossing or in the section house.

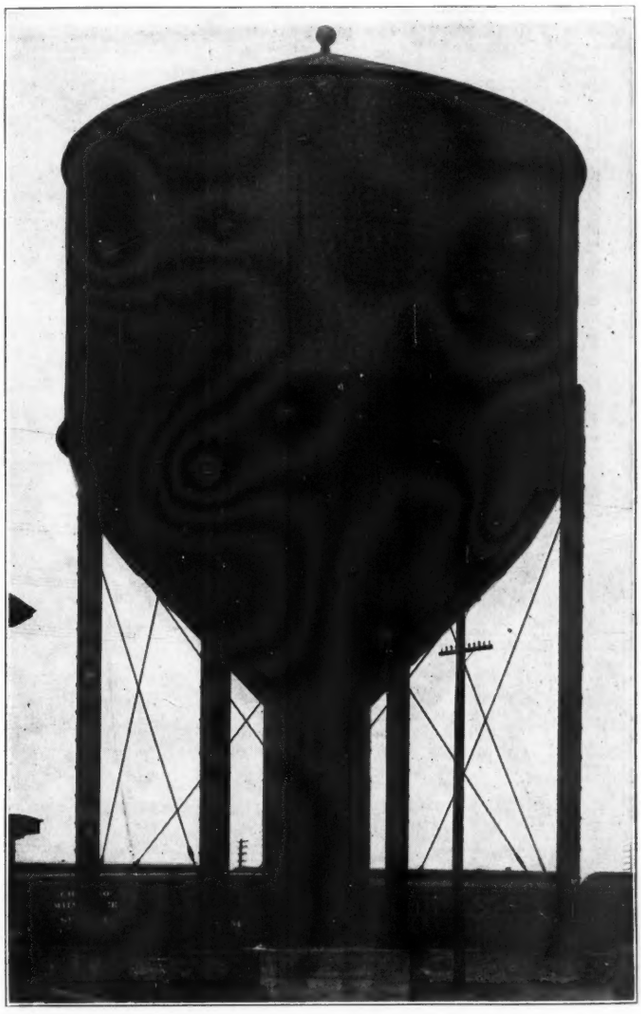
The car is driven by bevel gear to the rear axle, allowing two speeds in each direction. The brake is attached to the drive axle, and is of the enclosed expanding type which is used on high-grade automobiles.

The motor is a single cylinder, air-cooled, 4-cycle engine of 3½-in. bore and 4½-in. stroke. It is rated at four h. p. Three systems of ignition are provided. In addition to the combined battery and low tension magneto ignition, which is usually called dual ignition, this car has another complete system with its own spark coil, circuit breaker and spark plug. The motor is equipped with a force feed oiler and automatic carburetor.

STEEL TANKS IN CANADA.

The accompanying cut shows the type of tank being used on the new Grand Trunk Pacific and National Transcontinental railways in Canada. In this region the weather is extremely cold during several winter months, and in portions of the country there are tracts of timber subject to forest fires.

This tank was designed to meet these conditions. In order to make it fireproof, no wood is used in any part of the structure, and so far as possible the location is chosen so



Steel Water Tanks Used on Grand Trunk Pacific.

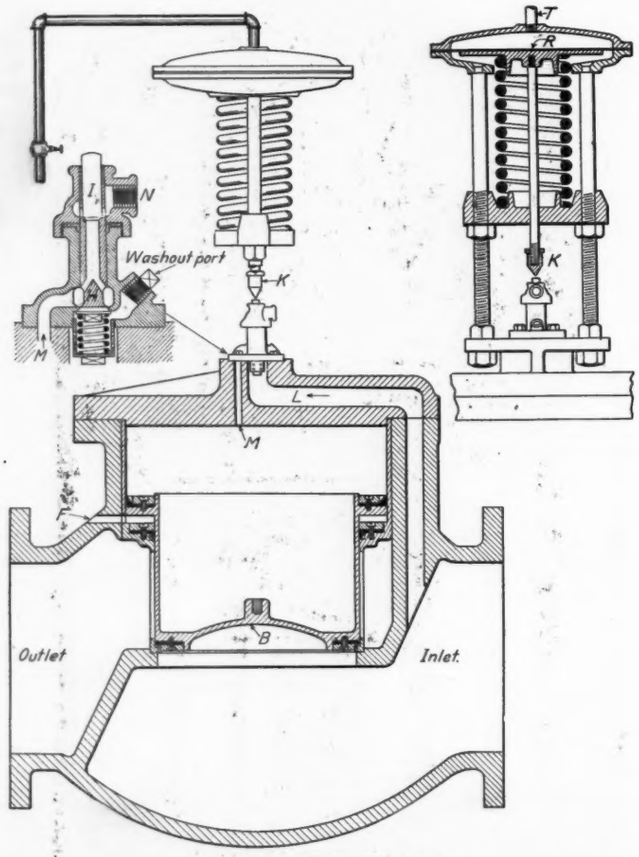
that forest fires will not be likely to affect the structure by warping its supports. The usual heating arrangement consisting of steam coil or hot water pipe was not considered equal to direct radiation on this work, as small pipes, if frozen, may burst and cause damage and serious inconvenience. It is also found preferable to have as small and simple a heating plant as possible. For these reasons and others, such as cost and ease of installation in these regions, the usual large steel riser has a diaphram or special flanged head about eight feet from the ground, below which no water is stored. The room formed below this diaphram is lined with fire brick, having an air space between brick and steel, or is built of concrete. A door of convenient dimensions is provided into this room and a coal or oil stove placed therein. The stovepipes pass directly up through the tank

and roof and water is kept from freezing by direct radiation from stovepipes and heating room. The supply and discharge pipes, also blow-off connection, pass down through the heating room to the ground.

A recent order placed with the Des Moines Bridge & Iron Co., Pittsburgh, Pa., calls for 29 of these structures, most of them to be erected during the present year.

AUTOMATIC CONTROLLING ALTITUDE VALVE

Several changes have been made in the Golden-Anderson automatic cushioned controlling altitude valve, which was described in the *Railway Age Gazette* of February 14, 1908, page 228. The most important of these is in the pilot valve, an enlarged section of which is shown on the drawing. When water is drawn from the tank or standpipe the pressure is



Improved Controlling Valve.

relieved from the top of the diaphragm *R*, causing the valve spindle *K* to raise, thus permitting the high pressure auxiliary valve *H* to close, and the exhaust valve *I* to open, allowing the water above the piston or valve *B* to escape through *M* and *N*. The water above the valve *B* acts as a cushion and when the valve begins to travel upward, air is drawn in through the port *F* and acts as a cushion when the valve closes.

When the water in the tank reaches the required height, the pressure in the pipe *T* and on top of the diaphragm *R* causes the valve spindle *K* to close the auxiliary exhaust valve *I* and open the high-pressure valve *H*, allowing the pressure to come on top of the valve B, which is forced to its seat, thus shutting off the water in its flow to the tank. The upper part of the body is lined with bronze, and the valve *B* is of solid bronze fitted with rubber cups and disc. These altitude valves are so constructed that electrical apparatus may easily be applied and they may be controlled from a distance, in addition to the automatic feature above described. The valve is made by the Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.

SCIENTIFIC SHOVELING.

The application of system to the use of shovels in construction and track work opens many possibilities for economy. The elaborate experiments made by Frederick W. Taylor in his analysis of the hand-shovel service at the Bethlehem Steel Co.'s plant, covering the handling of many kinds of material from iron ore to pea coal, showed that the most economic shovel load to be lifted and thrown a standard distance and height is 21 lbs.

To a degree the problem is one of education of men, but success seems to depend quite as much on the selection of the proper tool as on the development of the men. As the plan contemplates adapting the capacity of the shovel to the weight and character of the material it would seem to require a large stock of shovels. This is the only objection, and it sinks into insignificance when measured with the advantages gained by a standard and uniform load for each movement which becomes impressed on the mind of the workman by the fact that he has changed tools to secure a standard of efficiency.

In the moving of iron ore it was found that the average number of tons handled per man per day was increased from 16 to 59. The average earnings per day per man were increased from $1.15 to $1.88 and the cost of handling was reduced from $0.072 to $0.033 per ton. This system so improved the service that in the second year, when all the work in the yard was task work, it was estimated from the results of the first six months that the saving on the year would be from $75,000 to $80,000.

The application of a standard shovel in railroad track service is now almost an accomplished fact, a large number of roads having adopted a No. 2 for ballast work and tamping, A No. 3 would probably be better as a standard for this work under all conditions. The shovels used in Mr. Taylor's investigation were made by the Wyoming Shovel Works, Wyoming, Pa. Since the great saving made by adapting the shovel to the material has become known, this company is making shovels designed to handle 21 lbs. of any specified material. It has issued a booklet on scientific shoveling, which will be sent on request, in which many of the ways of effecting economy in earth handling by shovels are explained.

UNION SWITCH & SIGNAL COMPANY'S NEW APPARATUS.

The new signal apparatus recently brought out by the Union Switch & Signal Company includes the Type "F" interlocking machine, which is similar in design and principle to the electro-pneumatic type but has a number of improved features which give it a timely interest.

The type "P-3" electro-mechanical machine has also been improved since the exhibit last year. The combination board is made of moulded insulated compound and is built up of units of convenient size. The rollers are so arranged that either top or bottom half can be operated independently or both halves may be rigidly connected together. If one roller does not provide for sufficient contacts and one on either side has more than sufficient space, the bottom half of the second roller may be connected to the first and be made to operate with it. This is done by providing a crank at the bottom of each lever and connecting two adjacent cranks with a link.

Indication lamps are provided below levers for showing condition of track circuits and there is now a mechanical push button for the control of a calling-on-arm from the

same lever as a high arm without the necessity for a stick relay. The arrangement is such that with the lever normal the push button is locked normal and can be operated only when the lever is reversed. With the lever reversed if the button is pushed in it will be locked in until the lever is put normal when it will be automatically restored. There is also a time release.

Another new device is the electric light signal designed for daylight as well as night indications by light only. These light signals have been considerably improved within the last few months as the result of extensive installations particularly on electric railways. The new type consists of a wide sheetiron background in the center of which is mounted the lamp case containing two lenses. These lenses are shielded by a sheetiron hood so as to intensify the daylight indication. The whole device is suspended from the mast by a castiron bracket having a knuckle joint so that the signal may be adjusted to focus toward any desired point.

The new Model 12 polyphase relay consists of an induction motor movement similar to that of the radial type, but instead of having the contacts and fingers mounted radially they are arranged in a manner very similar to those of a direct current relay. The contacts are carried on a slate top. This can be furnished as a two or three position relay, 25 or 60 cycles, and for any voltage.

There are also two new transformers among the new apparatus. One is a standard track transformer and the other is a combined track transformer and reactance. Thus in this instrument two devices are combined, saving space and making for convenience in construction, maintenance, and operation.

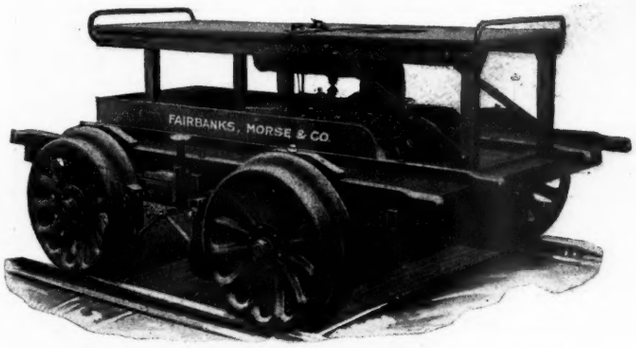
The new stationary automatic reactance is designed to secure a quadrature phase relation between the current in the track coil and that in the local coil of a polyphase track relay. The reactance is connected between the track and the track transformer and is so designed that with the block occupied, the power consumption and flow of current to the track are less than that with the block unoccupied.

The advantages are that it has no moving parts and cannot close up its magnetic circuit during wet weather and thus cause the track relay to open; and it gives ideal quadrature relation between the currents in the two elements of a polyphase track relay.

These and other recent developments are shown at the Union Exhibit at the Coliseum.

NEW FAIRBANKS-MORSE MOTOR CAR.

The Fairbanks-Morse Co., Chicago, has on exhibition at the Coliseum, a new motor car, the No. 29. It has a capacity

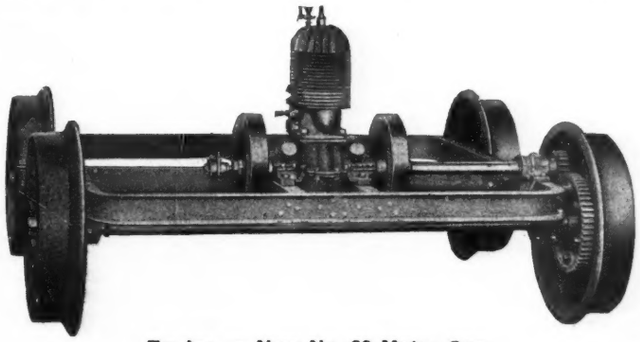


Fairbanks-Morse New No. 29 Section Motor Car.

of six to eight men, seated; weighs 800 lbs., and has a single cylinder, air-cooled, two-cycle, valveless engine, driving the car through a pinion on an extended shaft which meshes with a large gear located within one of the car wheels. The speed of the car is 6 to 18 miles per hour in either direction.

There are also on exhibit light inspection cars, Nos. 28 and 30, and larger cars Nos. 26, 32 and 33 for section, bridge and construction gangs.

The two-cycle engine, air-cooled, is applied to all the cars shown. As these cars go into the hands of many men inexperienced in handling machinery of any kind, the two-cycle engine has advantages for such service on account of its simplicity, having no valves, cams, pawls, gears, etc. Being air-cooled, any trouble from water freezing, etc., is obviated and this also helps to keep down the weight.

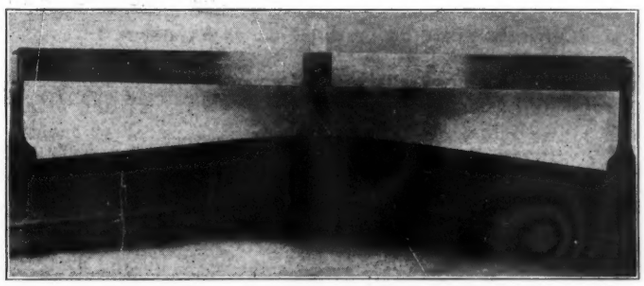


Engine on New No. 29 Motor Car.

Lubrication is a distinctive feature on these two-cycle engine cars, the oil and gasoline being mixed, one-half pint of oil to one gallon of gasoline, making it unnecessary for the operator to worry about the engine geting proper lubrication as the system is automatic.

AN IMPROVED DEVICE FOR MEASURING RAIL DEFLECTION.

The customary method of measuring the deflection of a rail under the drop test is to lay a steel straight edge of a given length, or frequently a wooden straight edge with steel corners, on the head of the rail and measure the deflection from the edge of this straight edge to the head of the rail with a rule. This has been found to give rise to considerable inaccuracy. In the first place the straight edges commonly used may themselves become inaccurate, because



A Device for Accurately Measuring Deflection of Rails.

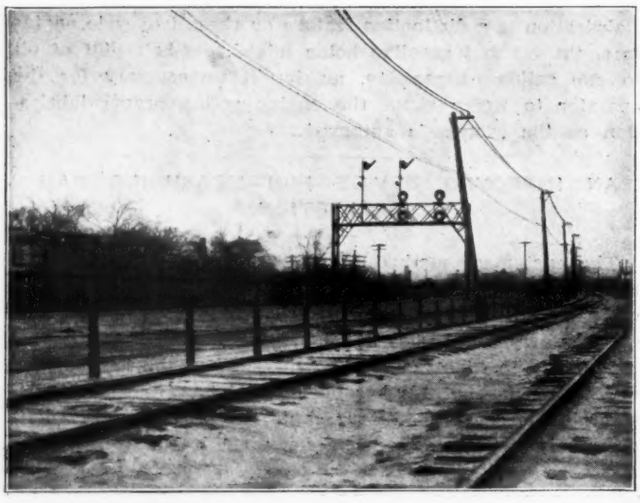
of wear or other reasons. Again, in falling upon the head of the rail the tup makes an indentation in the head. Also, quite frequently the web of the rail buckles more or less, especially under a second or third blow. When measuring from the head of the rail, this buckling and indentation are included in the deflection, and this may explain why there seems at times to be no relation between the deflection and the elongation.

To provide for a more accurate means of measuring this deflection, the device shown in the accompanying photograph has been made to measure the deflection on the base of the rail rather than on the head. This device consists of a steel

bar 3 ft. long, rigidly mounted on two standards, the bases of which are at right angles to the bar. These standards are made of hard steel with a high resistance to wear. In the center a graduated scale passes through a slot provided with springs to retard free movement. This scale is graduated to read to the nearest .05 in., the zero being even with the top of the scale when the lower end is in the plane with the bases of the standards. By simply placing this device on the rail, the scale is pushed up to show the proper deflection and the springs hold it there. It weighs 6.5 lb. This device was developed under the direction of C. W. Gennet, of R. W. Hunt & Co., and has been used by the inspectors of this company for six months at the south works and Gary mills of the Illinois Steel Co. It has given such satisfaction at these points that it is planned to install it in all of the mills in the near future.

D. & A. CONCRETE FENCE POSTS.

The Chicago & North Western established a small plant at Dunlap, Ia., in 1907 for the manufacture of concrete fence posts. This plant was of the open-air character, all work being done when possible in the open air. A small temporary building was erected for a cement storage house. The equipment used was purchased from the D. & A. Post



Concrete Posts on C. & N. W. at Evanston, Ill.

Mold Co., Three Rivers, Mich., and consisted of 265 molds for the 7 ft. line posts and 25 molds for the 8 ft. end and brace posts; also one mold shaker, with a capacity of 12 molds. Three men were employed in this plant, who were paid from 16.5 to 17.5 ct. per hour, and were able to make an average of 60 posts a day. The 7 ft. line posts cost 18.3 ct. each and the 8 ft. end or anchor posts cost 53 ct. each. The posts were reinforced with steel strips ⅛ in. by ⅝ in. and 6 ft. 10 in. long, the concrete mixture being one part cement to six parts gravel.

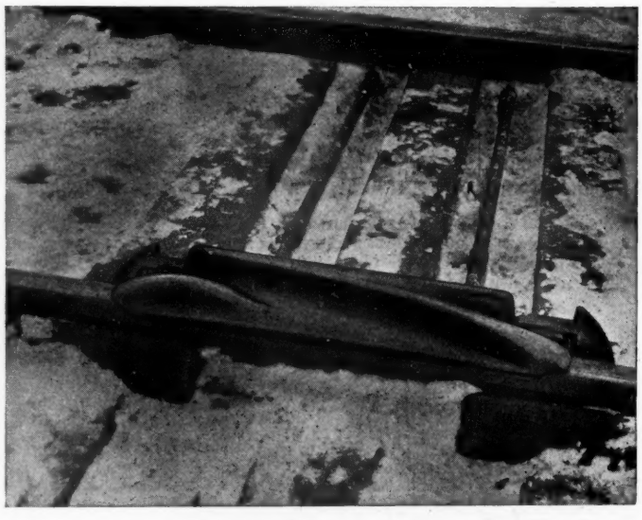
About 5,000 posts have been manufactured at this plant, most of which have been used in the territory between Dunlap and the Missouri river. The Boyer river for many years was a source of trouble to this portion of the line on account of floods at certain seasons of the year, one result of which was to lift up wooden fence posts and destroy long sections of the right of way fences. The company decided to replace the wooden posts in these fences with concrete, which has been done with satisfactory results. The posts, which were placed in 1907-8, are giving good satisfaction, but it is recommended that future posts be made 8 ft. long and that they have same additional reinforcement in order to further reduce the likelihood of breakage in handling. Some of the posts manufactured at the Dunlap plant have also been used in Evanston, Ill., between the rights of way of the Chicago & North Western and the Northwestern Elevated, as shown in the accompanying photograph.

NEW STEEL DERAIL CONSTRUCTION.

The derailing block of the Hobart-Allfree derailers is now made of cast steel, which is an improvement over previous forms. In addition to this the new design of the base pre-

The No. 5 Hand-Throw Derailer.

sents a smooth outline, and protects yardmen in making it impossible for them to get their feet caught in the device. Another feature of interest is the lip, which brings the lateral thrust incident to derailment directly against the rail rather than against the supporting base. Then, too, the derail is clamped directly to the rail, a feature designed to eliminate trouble caused by partial displacement or by damage during either a derailment or an accidental trailing through.



No. 7 Mechanical-Throw Derailer.

The No. 7 derail for mechanical throw is made longer so as to insure positive action at unexpected higher speeds as well as at low speeds. The No. 5 hand throw is also made of cast steel. This and the No. 7 are both on exhibition at space 107 in the Coliseum, by the Hobart-Allfree Co., Chicago.